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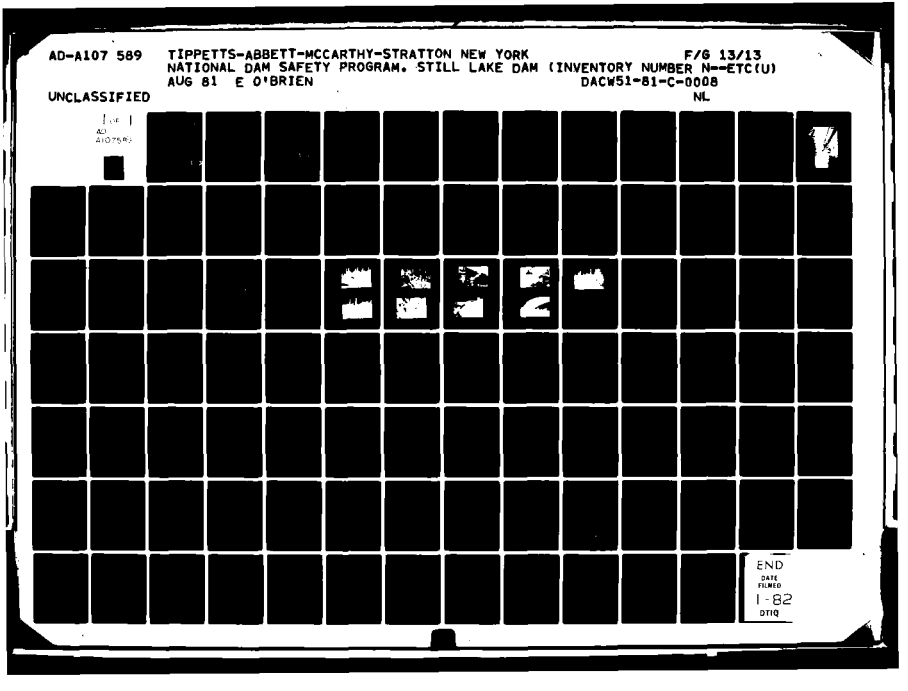

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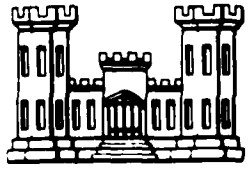
LEVEL II

LONG ISLAND BASIN

STILL LAKE DAM

WESTCHESTER COUNTY, NEW YORK
INVENTORY NO. N.Y. 1266

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



NEW YORK DISTRICT CORPS OF ENGINEERS

JULY 1981

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Phase I investigation of Still Lake Dam did not indicate conditions which constitute an immediate hazard to human life or property. The project, however, does have inadequacies and deficiencies which, if not remedied, have the potential for developing into hazardous conditions.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Using the Corps of Engineers screening criteria for review of spillway adequacy, it has been determined that the spillway is inadequate for all floods in excess of 4 percent of the Probable Maximum Flood (PMF). Overtopping of the dam would significantly increase the hazard to loss of life and property, and therefore, the spillway is adjudged as "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a "seriously inadequate" spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity and if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream of the dam.

Structural stability analyses based on available information and the visual inspection indicates that the stability of the spillway section against overturning is inadequate for all loading conditions except earthquake, whereas sliding is inadequate for all loading conditions.

The seepage condition which exists on the surfaces and downstream of the earth buttress should be investigated to determine its cause, the stability of the structure under the seepage forces, and to provide remedial measures.

LONG ISLAND BASIN

STILL LAKE DAM

WESTCHESTER COUNTY, NEW YORK
INVENTORY NO. N.Y. 1266

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NEW YORK DISTRICT CORPS OF ENGINEERS

JULY 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C., 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
STILL LAKE DAM
I.D. NO. N.Y. 01266
DEC. NO. 214B-819
HUDSON RIVER BASIN
WESTCHESTER COUNTY, N.Y.

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APPENDICES

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NAME OF DAM	Still Lake Dam, N.Y. 01266
STATE LOCATED	New York
COUNTY LOCATED	Westchester
STREAM	Unknown
BASIN	Lower Hudson River
DATE OF INSPECTION	17 March 1981

ASSESSMENT

Phase I investigation of Still Lake Dam did not indicate conditions which constitute an immediate hazard to human life or property. The project, however, does have inadequacies and deficiencies which, if not remedied, have the potential for developing into hazardous conditions.

Using the Corps of Engineers screening criteria for review of spillway adequacy, it has been determined that the spillway is inadequate for all floods in excess of 4 percent of the Probable Maximum Flood (PMF). Overtopping of the dam would significantly increase the hazard to loss of life and property, and therefore, the spillway is adjudged as "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a "seriously inadequate" spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary

computations, there appears to be a serious deficiency in spillway capacity and if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream of the dam.

Structural stability analyses based on available information and the visual inspection indicates that the stability of the spillway section against overturning is inadequate for all loading conditions except earthquake, whereas sliding is inadequate for all loading conditions.

The seepage condition which exists on the surfaces and downstream of the earth buttress should be investigated to determine its cause, the stability of the structure under the seepage forces, and to provide remedial measures.

It is therefore recommended that within 3 months of notification to the owner, detailed hydrologic/hydraulic investigations of the structure should be undertaken to more accurately determine the site specific characteristics of the watershed and their affect upon the overtopping potential of the dam. The results of these investigations will determine the appropriate remedial measures which will be required to achieve a spillway capacity adequate to discharge the outflow from at least the one-half (1/2) PMF event. Within 12 months of the date of notification to the owner, modifications to the structure, deemed necessary as a result of studies, should have been completed. At the same time, a detailed investigation of the structural stability of the spillway and the seepage condition and subsequent analysis should be performed. In the interim, a detailed emergency action plan must be developed and implemented during periods of unusually heavy precipitation. Also, around-the-clock surveillance of the structure must be provided during these periods.

In addition, the dam has other problem areas which, if left uncorrected, have the potential for the development of hazardous conditions and must be corrected within one year. These areas are:

1. Monitor at biweekly intervals with the aid of weirs and/or other measuring devices, the seepage occuring on the surfaces and downstream of the earth buttress.

2. Remove heavy brush, shrubs, trees and debris from the surfaces of the downstream earth buttress. Provide a program of periodic cutting and mowing of all embankment surfaces.

3. Place riprap or boulders at the toe of the spillway chute to provide proper energy dissipation and prevent erosion and undermining.

4. Provide a program of periodic inspection and maintenance of the dam and appurtenances, including yearly operation and lubrication of the reservoir drain and its control facilities. Document this information for future reference. The aforementioned emergency action plan should be maintained and updated periodically during the life of the structure.

Eugene O'Brien, P.E.
New York No. 29823

Approved by:

Col. W.M. Smith, Jr.
New York District Engineer

Date: 05 AUG 1981

OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
STILL LAKE DAM
I.D. NO. N.Y. 01266
HUDSON RIVER BASIN
WESTCHESTER COUNTY, N.Y.

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers Contract No. DACW 51-81-C-0008 in a letter dated 14 December 1980 in fulfillment of the requirements of the National Dam Inspection Act, Public Law 92-367, dated 8 August 1972.

b. Purpose

This inspection was conducted to evaluate the existing conditions of the dam, to identify deficiencies and hazardous conditions, to determine if these deficiencies constitute hazards to life and property, and to recommend remedial measures where required.

1.2 DESCRIPTION OF THE PROJECT

a. Description of the Dam and Appurtenant Structures

Still Lake Dam is a stone/masonry gravity structure with upstream and downstream earth buttresses. The combined crest width of the gravity structure and the downstream earth buttress is 10.5 feet. The top of the upstream buttress is 3.5 feet below the gravity crest, and is of unknown width and shape. The maximum structural height of the dam is 16 feet.

The dam is about 540 feet long and consists of three linear segments: the right, the center and the left segment. The length of each segment is 200 feet, 20 feet and 320 feet, respectively. The segments are connected and form a "dog-leg" type configuration.

The downstream earth buttress has a grassed downstream slope, approximately 1V:2H (vertical to horizontal). The upstream buttress is unprotected and has an approximate 1V:6H slope extending an unknown distance upstream of the centerline.

The overflow section of the dam is an uncontrolled stone masonry structure about 15 feet in height located about 60 feet from the right abutment contact. The top of the spillway is a broad-crested concrete sill, 9.5 feet long and 3.5 feet wide.

Above the sill is a thin concrete arched bridge; at its maximum point, the bottom of the arch is 1.5 feet above the sill crest. The downstream face of the spillway consists of 12 steps, each approximately one foot high and wide. A concrete chute, approximately 30 feet long, is located at downstream edge of the structure.

A 24-inch steel pipe serves as a reservoir drain for the project. The drain is located beneath the spillway structure and is controlled by a valve located about two feet upstream of the crest of the dam and operated by a rotating T-bar control.

Discharge over the spillway and through the drain enter into the same downstream discharge channel. The channel is located at downstream edge of the chute, and extends perpendicular to the dam for its first 200 feet, wherein it follows a circuitous path.

b. Location

The dam is located in Ossining, Westchester County, New York. The dam is located approximately four miles northeast of the City of Ossining.

c. Size Classification

The dam has a structural height of 16 feet and a reservoir storage capacity of 150 acre-feet. The dam is classified as "small" in size (50 to 1,000 acre-feet).

d. Hazard Classification

The dam is classified as "high" hazard due to the number of homes located downstream; two of these homes are less than 200 feet downstream of the dam.

e. Ownership

The dam is owned and operated by the Still Water Lake Association. The President of the Association is Mr. Barry Shainman, Adams Road, Ossining, New York, 10562, Telephone No. (914) 762-1180.

f. Purpose

Still Lake Dam creates a recreational pool for use by members of the Association.

g. Design and Construction History

The dam was constructed about 1930. No information is available regarding its design and construction history.

h. Normal Operating Procedure

Water release from the lake is uncontrolled through the broad-crested sill. According to Mr. Saltzman, the Association representative who was present during this inspection,

the reservoir drain is operated when the need arises, and usually in the fall to allow for collection of spring runoff.

1.3 PERTINENT DATA

a.	Drainage Area, Square Miles	0.22
b.	Discharge at Damsite, cfs	
	Maximum Known Flood at Damsite	Unknown
	Spillway: Maximum Pool	30
	Reservoir Drain: Maximum Pool (Top of Dam)	Unknown
c.	Elevation, USGS Datum (MSL)	
	Maximum Pool	487 feet
	Normal Pool	486 feet
	Spillway Concrete Sill	486 feet
d.	Reservoir	
	Length of Maximum Pool	1600+ feet
	Length of Normal Pool	1600 feet
e.	Storage	
	Maximum Pool	177 acre-feet
	Normal Pool	150 acre-feet
f.	Reservoir Surface	
	Maximum Pool	26.2 acres
	Normal Pool	24.3 acres
g.	Dam	
	Type	Gravity Structure with Upstream and Downstream Earth Buttresses
	Length	540
	Height	16 feet
	Crest Width: Total	10.5 feet
	Concrete	2.5 feet
	Downstream Earth Buttress	8 feet
	Earth Buttress Slopes: Downstream, (V:H)	1:2
	Upstream	Unknown
h.	Reservoir Drain	
	Type	Steel Pipe
	Diameter	24-Inch
	Closure	Valve

i.	Spillway Type	Uncontrolled, Stone/ Masonry Stepped Structure with Broad-Crested Sill
	Height	16 feet
	Width	3.5 feet
	Location	60 feet from Right Abutment Contact
	Side Walls	Stone/Masonry

SECTION 2- ENGINEERING DATA

2.1 GEOLOGY

Still Lake Dam is located in the New England Upland Section of the New England Maritime Physiographic Provice[4]. The bedrock in this section consists of metamorphic, igneous and sedimentary rocks which have undergone a complex sequence of deposition, folding, faulting and erosion. In the vicinity of the damsite, the rock comprises schistose gneiss of Precambrian Age[5]. The local relief is that of a maturity dissected peneplain modified by continental glaciation.

2.2 SUBSURFACE INVESTIGATIONS

No subsurface information is available for the project. The soil deposits which exist in the vicinity of the damsite are primarily glacial tills deposited during the Late Pleistocene Age. The till is composed primarily of gravels, silts and sands.

2.3 DESIGN RECORDS

No design records are available for the project.

2.4 CONSTRUCTION RECORDS

No construction records are available for the project.

2.5 OPERATION RECORDS

No operation records exist for the project.

2.6 EVALUATION OF DATA

There are neither design records nor construction records, however information obtained from personal interviews and observation made during the visual inspection are considered adequate for Phase I inspection.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

A visual inspection of Still Lake Dam was made on 17 March 1981. The weather was clear and sunny and the temperature was in the mid-fifties (^{O}F). At the time of this inspection, the reservoir level was approximately two feet below the crest of the dam.

b. Dam

The exposed concrete surfaces of the dam appear to be in good condition; no structural cracking or deterioration was observed (See OVERVIEW). The vertical and horizontal alignment of the gravity crest and the downstream earth buttress crest are good. The alignment of the submerged upstream buttress crest could not be determined.

The surfaces of the downstream buttress contain debris, boulders, fallen trees and vegetation consisting of small bramble bushes to trees of large diameter (24-inch) (See PHOTOGRAPH 1). No surface cracking, movement at the toe or other signs of instability were observed along these surfaces.

The crest of the upstream earth buttress was, at the measured locations, 3.5 feet below the gravity crest. The submerged upstream slope was about 1V:6H, up to 15 feet from the exposed vertical upstream face of the gravity structure. According to Mr. Saltzman, there is a sharp drop in the lake bottom (or upstream buttress slope) approximately 20 feet upstream of the gravity crest.

Swamp-like vegetation and wet ground were observed along the surfaces of the downstream earth buttress and up to 40 feet downstream of the buttress toe. This condition appeared to occur along the entire length of the dam (See PHOTOGRAPHS 2, 3 and 4). In addition, an approximate 15 foot wide by 40 foot long wet area was observed near the right abutment contact. Channels have been constructed along the downstream toe by local residents to collect the seepage. In addition, a 4-inch diameter vitrified clay pipe was installed along the toe of the right buttress (to the right of the spillway section) to collect seepage in that area. This pipe discharges into the downstream spillway channel; the flow was measured to be 1$\pm$ gpm and the water was clear. No boils or other evidence of high water pressures were observed.

There is no emergency action plan for the project.

c. Spillway Section

The condition of the stone/masonry downstream steps and concrete chute is good (See PHOTOGRAPHS 6 and 7). There has been little to no deterioration; the stone appears durable and resistant to erosion and weathering. No leaks were observed through the structure. The spillway concrete sill and arch show minor signs of distress (See PHOTOGRAPH 8). The upstream surface of the spillway section could not be observed due to the existence of the upstream earth buttress. The downstream stone/masonry sidewalls appear to be in good condition (See PHOTOGRAPH 6).

d. Appurtenant Structures

The reservoir drain was not operated during this inspection, since Mr. Saltzman was unfamiliar with the valve operation. It is reported, however, that this valve is operational. No maintenance of the drain control facilities were reported.

The exposed downstream portion of the reservoir drain appears to be in good condition. The downstream channel contains small-size riprap along its sides and some vegetation (See PHOTOGRAPH 7). The area adjacent to the channel is relatively flat. Two homes exist along the banks of the channel within its first 200 feet downstream of the dam. Little or no riprap exists within the channel at the downstream edge of the spillway apron (See PHOTOGRAPH 9).

e. Reservoir

Still Lake is bordered by the Taconic State Parkway to the east and Pines Bridge Road to the south.

There are no visible signs of instability or sedimentation problems in the reservoir area.

f. Abutments

A relatively large wet area, as previously reported, was located near the right abutment contact.

3.2 EVALUATION OF OBSERVATIONS

The seepage condition which was observed requires immediate investigation to determine the extent of corrective action which is required. The following summarizes this condition as well as those previously reported, in order of importance, along with appropriate remedial action:

1. The seepage occurring along the downstream slope, at the toe and downstream of the toe, and near the left abutment contact, must be investigated immediately. Construction of weirs and monitoring of flow at biweekly intervals should be performed to determine the nature and extent of this seepage.

2. Heavy brush, shrubs, trees and debris should be cut and/or removed from the surfaces of the downstream earth buttress. A program of periodic cutting and mowing should be initiated. Inspections should be made to determine if removal and/or cutting of vegetation will adversely affect the condition of the dam.

3. Riprap or boulders should be placed at the toe of the spillway chute.

4. The reservoir drain and its control facilities should be inspected and maintained on a yearly basis. This information should be documented for future reference.

5. Provide a program of periodic inspection and maintenance of the dam and appurtenances including yearly operation and lubrication of the reservoir drain at its control facilities. Document this information for future reference. Develop an emergency action plan.

SECTION 4 - OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

No written operation and maintenance procedures exist for the project. It is reported that the reservoir drain is operated when the need arises, and usually in the fall to allow for storage or spring runoff.

4.2 MAINTENANCE OF DAM

It is reported that the dam is not maintained on a regular basis. No formal maintenance program or manual exists for the project.

4.3 WARNING SYSTEM IN EFFECT

No warning system is either in effect or preparation.

4.4 EVALUATION

The dam and appurtenances have not been adequately maintained, as evidenced by the seepage problems reported in "SECTION 3 - VISUAL INSPECTION".

SECTION 5 - HYDROLOGIC/HYDRAULIC

5.1 DRAINAGE AREA CHARACTERISTICS

Still Lake Dam is located northeast of Ossining in New Castle Township, Westchester County, New York (Hydrologic Unit Code 02030101) at the intersection of the Taconic Parkway and Pines Bridge Road. The drainage area contributing to the lake is 140.5 acres (0.22 square miles) of wooded gently sloping terrain with relatively little development. The lake occupies approximately 17 percent of the drainage area.

5.2 ANALYSIS CRITERIA

The analysis of the capacity of the service spillway was performed using the HEC-1DB computer program[1]. A unit hydrograph was developed using Snyders coefficient of C_T = 2 and 640 C_p = 325. The all season Probable Maximum Precipitation for 200 square miles in 24 hours of 22 inches was obtained from the Weather Bureau's Hydrometeorological Report No. 33 and distributed over 48 hours[2]. In accordance with the "Recommended Guidelines for Safety Inspection of Dams"[3], the adequacy of the spillway was analyzed using the Probable Maximum Flood (PMF).

5.3 SPILLWAY CAPACITY

The principal spillway of Still Lake Dam is 9.5 feet in length with a crest elevation of 486, 1.0 feet below the top of the dam. The spillway is assumed to act as a broad-crested weir and the computed maximum discharge with a head of 1.0 feet is 30 cfs.

5.4 RESERVOIR CAPACITY

The normal capacity of Still Lake is listed as 150 acre-feet with 27 acre-feet of surcharge storage, which is equivalent to about 2.3 inches of runoff over the entire basin.

5.5 FLOODS OF RECORD

There are no records available of floods or maximum lake elevations; however, it is reported that the dam has never been overtopped.

5.6 OVERTOPPING POTENTIAL

The potential of the dam being overtopped was investigated on the basis of the spillway discharge capacity and the available surcharge storage to meet the selected design flood inflows.

The computed PMF, routed through the lake resulted in a maximum lake elevation of 487.54 feet, 0.54 feet above the top of the dam. Duration of flow over the dam was 12.3 hours, and the peak outflow was 718 cfs. One-half (1/2) the PMF raised the lake elevation to 487.32 feet with a peak discharge of 351 cfs. Lake elevation was assumed to be 486 (spillway crest elevation) at the start of the flood event.

A summary of the HEC-1DB multi-plan analysis is listed below.

RATIO OF PMF	PEAK INFLOW (cfs)	PEAK OUTFLOW (cfs)	MAXIMUM DEPTH OVER DAM (ft)
1.00	729	718	0.54
0.75	546	535	0.44
0.50	364	351	0.32
0.25	182	133	0.15

5.7 EVALUATION

The Still Lake Dam spillway is capable of discharging only 4 percent of the PMF without the dam being overtopped. The overtopping could cause the failure of the dam thus significantly increasing the hazard to the loss of life downstream. Therefore, the spillway is assessed as being "seriously inadequate".

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Visual observations did not indicate conditions which are an immediate hazard to life and property. However, the seepage condition which exists on the surfaces and downstream of the downstream earth buttress should be investigated to determine its cause, the stability of the dam and to provide remedial action. Although it is not an immediate hazard to life and property, if left uncorrected, this condition is potentially hazardous to life and property downstream of the dam.

b. Design and Construction Records

No design drawings, construction records or other pertinent project information is available for the project.

c. Operating Records

No operating records are kept for the project.

d. Post-Construction Changes

No post-construction changes have been reported.

e. Seismic Stability

In accordance with recommended Phase I guidelines, the dam is located in Seismic Risk Zone 1. However, based on local seismic experience, the New York State Geological Survey recommends that the damsite is to be considered in Zone 2. Therefore, the stability of the spillway was determined using a seismic coefficient of 0.05g.

6.2 STRUCTURAL STABILITY ANALYSIS

Since there are no design drawings for the project, the geometry of the spillway section for stability analyses was based on visual observations and engineering judgment. In addition the analysis was performed in accordance with the Corps of Fngineers guidelines (Ref. 3). A detailed sketch along with stability computations is presented in Appendix E. A description of the cases examined and a summary of the results of the analyses are presented below.

Case	Description of Loading Conditions
1	Normal Loading, Lake Level at El 486, No Tailwater, Full Uplift
2	Same as Case 1, with 5 K/LF, Ice Load
3	Unusual Loading, 1/2 PMF, Lake Level at 486.32, Tailwater 1.7 Feet.

Case	Description of Loading Conditions
4	Extreme Loading, Full PMF, Lake Level at 486.52, Tailwater 2.4 Feet
5	Unusual Loading, Case 1 with Earthquake Loading (Zone 1, n = 0.05)

SUMMARY OF RESULTS

Case	Location of Resultant	Sliding Factor of Safety
1	0.34ft Outside Middle Third	1.63
2	6.77ft Oustide Middle Third	1.13
3	1.53ft Outside Middle Third	1.43
4	1.77ft Outside Middle Third	1.40
5	Within Base	1.37

The results of the stability analysis indicate that the stability of the section analyzed is inadequate in overturning except for earthquake loading, and inadequate in sliding for all loading conditions. The configuration of the gravity spillway structure and the upstream earth buttress should be determined to more accurately evaluate the stability of the structure. After obtaining this information, an in-depth structural stability analysis should be conducted.

SECTION 7 - ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety

Phase I investigation of Still Lake Dam does not indicate conditions which constitute an immediate hazard to human life or property. Based on engineering judgment and the performance of the dam, the project appears to be in fair condition. The project, however, does have inadequacies and deficiencies which, if not remedied, have the potential for developing into hazardous conditions.

Using the Corps of Engineers screening criteria for initial review of spillway adequacy, it has been determined that the spillway is inadequate for all floods in excess of 4 percent of the Probable Maximum Flood. Overtopping of the dam would significantly increase the hazard to loss of life and property, and therefore, the spillway is adjudged as "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a "seriously inadequate" spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity and if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard to loss of life downstream of the dam.

Structural stability analyses based on available information and the visual inspection indicates that the stability of the spillway section against overturning is inadequate for all loading conditions except earthquake, whereas sliding is inadequate for all loading conditions.

b. Adequacy of Information

The lack of in-depth engineering data did not allow for a definitive assessment. Therefore, the adequacy of the dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Need for Additional Investigations

The following investigations are required to be performed by a licensed engineer experienced in dam engineering:

1. Investigate the site specific characteristics of the watershed to more accurately determine the hydrologic/hydraulic capabilities of the dam and watershed. Conduct studies to determine what measures are necessary to improve discharge capacities.

2. Determine the exact geometry of the gravity structure and the material properties of the downstream and upstream earth buttress and foundation. Perform an in-depth structural stability analysis.

3. Investigate the seepage condition which exists along the surfaces of the downstream earth buttress, downstream of the buttress, and near the right abutment contact, and to recommend measures to eliminate these conditions.

d. Urgency

The additional required investigations described above must be initiated within 3 months from the date of notification. Within one year of notification, remedial measures as a result of this investigation must be initiated, with completion of these measures during the following year. In the interim, develop an emergency action plan for notification of downstream residents and proper governmental authorities in the event of overtopping and provide around-the-clock surveillance of the dam during periods of extreme runoff. The other deficiencies as reported below must be corrected within one year of notification.

7.2 RECOMMENDED MEASURES

1. The results of the aforementioned in-depth investigations will determine the appropriate remedial measures required.

2. Monitor at biweekly intervals with the aid of weirs and/or other measuring devices, the seepage through and under the dam.

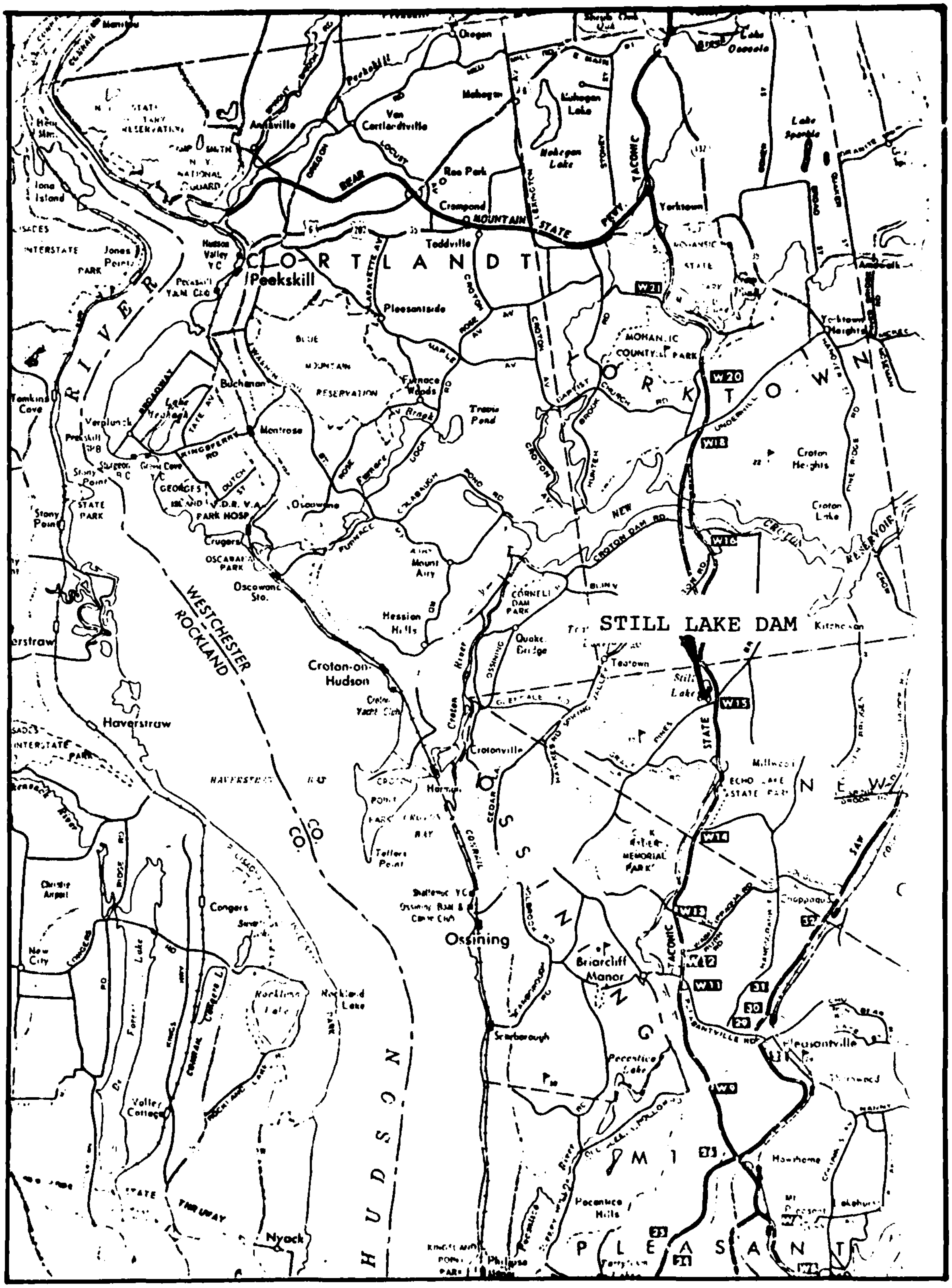
3. Remove vegetation and debris from the surfaces of the downstream earth buttress. Provide a program of periodic cutting and mowing of all embankment surfaces. Inspections should be made to determine if removal and/or cutting of vegetation will adversely affect the condition of the dam.

4. Place riprap or boulders at the toe of the spillway chute to provide proper energy dissipation and prevent erosion and undermining.

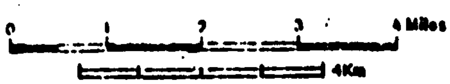
5. Provide a program of periodic inspection and maintenance of the dam and appurtenances, including yearly operation and lubrication of the reservoir drain valve and its control facilities. Document this information for future reference. The emergency action plan described in Section 7.1(d) should be maintained and updated periodically during the life of the structure.

DRAWINGS

APPENDIX A



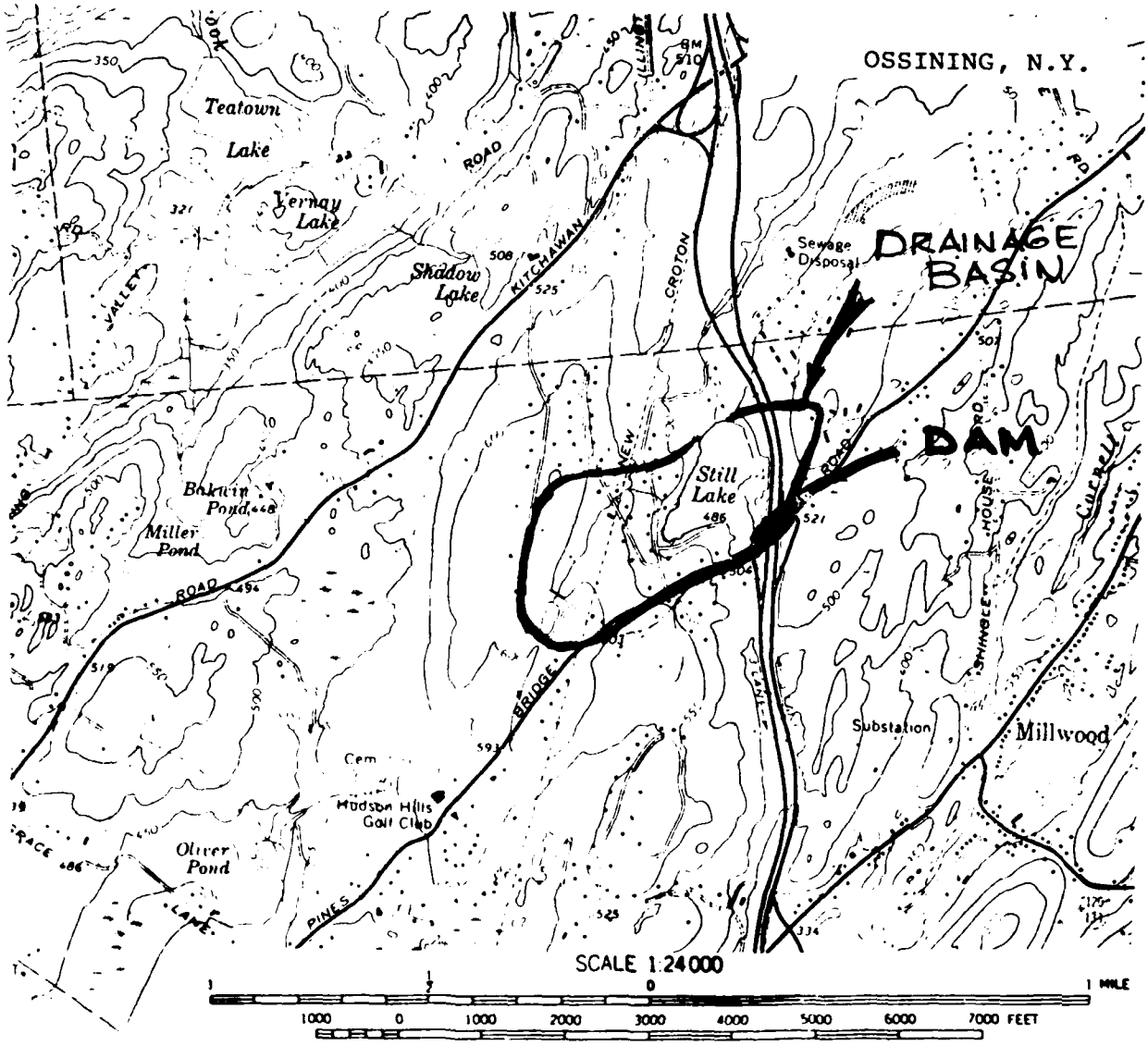
SCALE



LOCATION MAP

Still Lake Dam

PLATE 1



TOPOGRAPHIC MAP

STILL LAKE DAM

PLATE 2

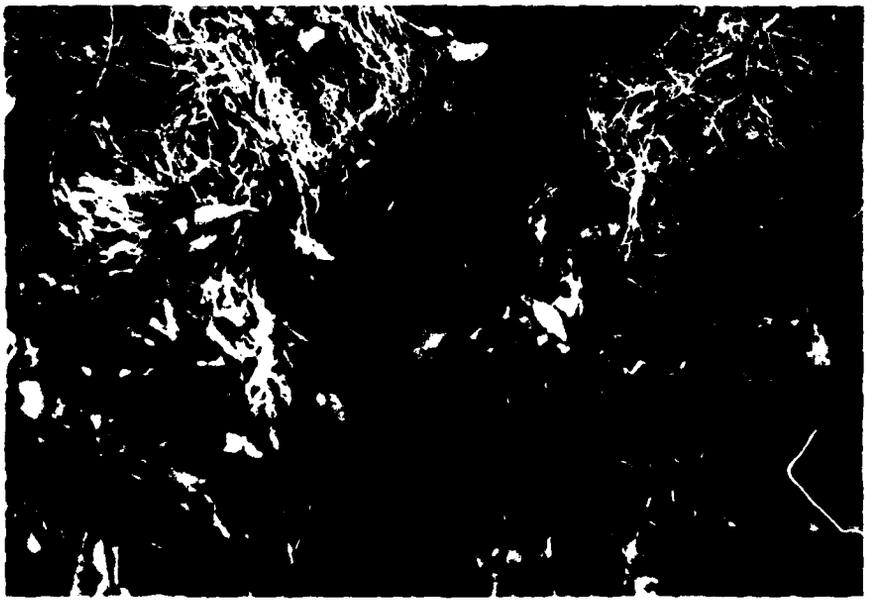
PHOTOGRAPHS

APPENDIX B

PHOTOGRAPH 1. CONDITION OF DOWNSTREAM SLOPE OF EARTH BUTTRESS (OBSERVE DEBRIS AND VEGETATION)

PHOTOGRAPH 2. SEEPAGE THROUGH DAM (OBSERVE SWAMP-LIKE VEGETATION AT TOE)

PHOTOGRAPH 3. WET GROUND APPROXIMATELY 40 FEET DOWNSTREAM OF DAM

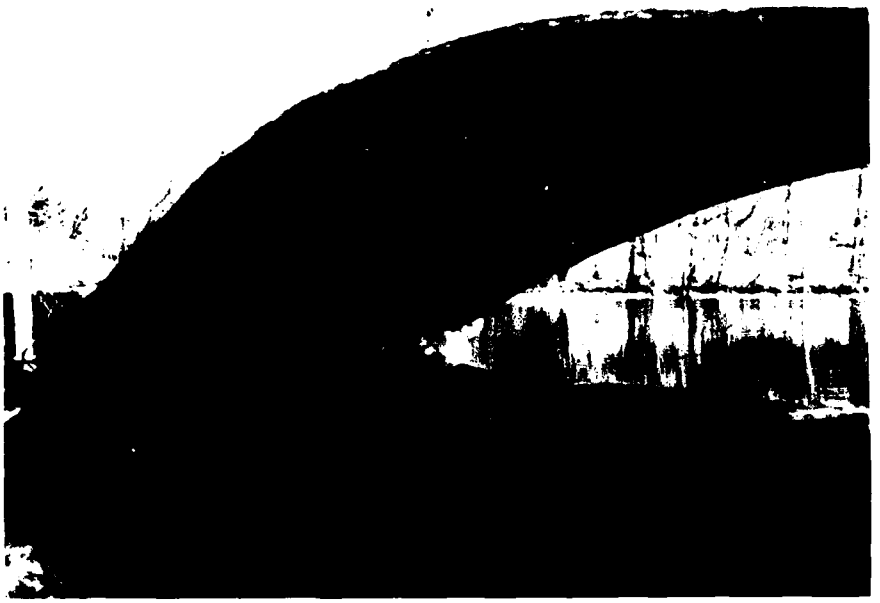


PHOTOGRAPH 4. SEEPAGE DOWNSTREAM OF DAM

PHOTOGRAPH 5. CHANNEL DOWNSTREAM AND PARALLEL TO DAM TO COLLECT SEEPAGE

PHOTOGRAPH 6. SPILLWAY

PHOTOGRAPH 7. CONDITION OF SPILLWAY CHUTE AND DOWNSTREAM CHANNEL



PHOTOGRAPH 8. CONDITION OF BROAD-CRESTED CONCRETE SILL

PHOTOGRAPH 9. AREA DOWNSTREAM OF DAM

VISUAL INSPECTION CHECKLIST

APPENDIX C

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam Still Lake Dam

Fed. I.D. # NY01266 DEC Dam No. Unknown

River Basin Lower Hudson River

Location: Town Ossining County Westchester

Stream Name None

Tributary of New Croton Reservoir

Latitude (N) 41° 12.2' Longitude (W) 073° 48.6'

Type of Dam Masonry - Earthfill Buttress

Hazard Category High

Date(s) of Inspection 17 March 81

Weather Conditions Sunny, 55°F

Reservoir Level at Time of Inspection 2.25ft below dam crest

b. Inspection Personnel Mr Harvey Feldman and Mr. Albert DiBernardo

c. Persons Contacted (Including Address & Phone No.)

Mr. Irv Saltzman (914) 762-0041

Ossining, New York 10562

Mr. Barry Shainman (914) 762-1180

Adams Road, Ossining, New York 10562

d. History:

Date Constructed 1930 Date(s) Reconstructed Not Applicable

Designer Unknown

Constructed By Unknown

Owner Still Water Lake Association

2) Embankment

a. Characteristics

(1) Embankment Material Earthfill material; has consistency of a silt or sandy silt

(2) Cutoff Type Unknown, however there is believed to be none

(3) Impervious Core None

(4) Internal Drainage System A buried vitrified clay pipe extends along the downstream toe to the right of the spillway section (facing d/s)

(5) Miscellaneous No drawings for the dam exist. It appears that the concrete structure is buttressed by an upstream earth buttress as well as a downstream earth buttress; however, the upstream buttress could not be inspected because it was submerged.

b. Crest

(1) Vertical Alignment The vertical alignment of the concrete wall and the d/s earth buttress is good with no sags or depressions

(2) Horizontal Alignment The dam contains a dog leg approximately 200ft from the right abutment contact.

(3) Surface Cracks None were observed along the embankment crest nor the concrete crest

(4) Miscellaneous None

c. Upstream Slope (Upstream Earth Buttress)

(1) Slope (Estimate) (V:H) 1:6 (very approx due to submergence)

(2) Undesirable Growth or Debris, Animal Burrows None was observed.

(3) Sloughing, Subsidence or Depressions Could not be determined due to submergence of the slope

(4) Slope Protection None was visible

(5) Surface Cracks or Movement at Toe Unknown

d. Downstream Slope

(1) Slope (Estimate - V:H) 1:2

(2) Undesirable Growth or Debris, Animal Burrows Trees up to 2'ϕ, small saplings and brush and some debris exist

(3) Sloughing, Subsidence or Depressions None observed

(4) Surface Cracks or Movement at Toe None observed

(5) Seepage Seepage exists along the entire length of the dam, with some locations worse than others. The seepage areas are generally located 20 to 40 ft from the embankment toe. No seepage was observed through the embankment

(6) External Drainage System (Ditches, Trenches; Blanket) Ditches exist, however they were installed by the local landowner to channel the seepage

(7) Condition Around Outlet Structure Generally in good condition with only minor siltation at invert of outlet pipe

(8) Seepage Beyond Toe See note No. (5) directly above. Also it was reported that one house just d/s of the dam has a continually wet basement.

e. Abutments - Embankment Contact

Appear to be free of leaks and does not show signs of instability.

(1) Erosion at Contact None

(2) Seepage Along Contact None

3) Drainage System

a. Description of System A vitrified clay pipe (12"Ø) collects seepage through the dam, to the right of the spillway section. The pipe was flowing, and appears to be uncloaged. It is unknown whether an internal drainage system exists.

b. Condition of System See (a.)

c. Discharge from Drainage System A small quantity of flow was recorded exiting the vitrified clay pipe.

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.)

None

5) Reservoir

a. Slopes The Taconic Parkway Embankment bounds the lake to the west All slopes appear stable.

b. Sedimentation The water was relatively clear Sedimentation does not appear to be a problem

c. Unusual Conditions Which Affect Dam None

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) A number of summer and year-round homes exist downstream of the dam

b. Seepage, Unusual Growth Seepage was observed along the entire length of typically 20 to 40 feet from the toe

c. Evidence of Movement Beyond Toe of Dam None

d. Condition of Downstream Channel The downstream channel is straight for the first 150 ft (approx) d/s of the spillway chute and then is diverted through a constricted stone structure.

7) Spillway(s) (Including Discharge Conveyance Channel)

The spillway exists approximately 80 feet from the right abutment contact

a. General The spillway consists of a broad crested weir with an arched concrete top, i.e  where y = 1.5' & x = 9.5 ft The water flows through the weir down an approximate 12 step structure constructed of boulder masonry. Prior to entering the channel, flow is channeled down a concave upward masonry chute

b. Condition of Service Spillway

The spillway appears to be in good condition, however, concrete constructions at each side of the weir exist. The surface of the masonry chute was very irregular, either due to erosion or poor construction techniques.

c. Condition of Auxiliary Spillway Not Applicable

d. Condition of Discharge Conveyance Channel The downstream channel is clear of obstructions and in generally good condition It is approx. 6 ft wide and 3ft deep and has rock protected side slopes The channel is relatively straight for the first 150 ft (approx) d/s of the dam

3) Reservoir Drain/Outlet

Type: Pipe ✓ Conduit _____ Other _____

Material: Concrete _____ Metal ✓ Other _____

Size: 2 feet Length Unknown

Invert Elevations: Entrance Unknown Exit Unknown

Physical Condition (Describe): Unobservable _____

Material: Steel, appeared to be in good condition at the outlet

Joints: Unknown Alignment Unknown

Structural Integrity: Flow through the pipe was not permitted since no one could operate the regulating valve.

Hydraulic Capability: Unknown (See above)

Means of Control: Gate _____ Valve ✓ Uncontrolled _____

Operation: Operable _____ Inoperable _____ Other Unknown*

Present Condition (Describe): Unknown

* However, according to Mr. Saltzman, the drain has been operated in the past.

9) Structural

a. Concrete Surfaces The concrete surfaces appeared to be in good condition with minor bulging occurring at a few locations along the upstream face.

b. Structural Cracking No major structural cracks were observed

c. Movement - Horizontal & Vertical Alignment (Settlement) The vertical and horizontal alignment appear good

d. Junctions with Abutments or Embankments The earth buttress(es) appear to be in good contact with the concrete wall.

e. Drains - Foundation, Joint, Face None located except for that which was previously mentioned.

f. Water Passages, Conduits, Sluices None except for the low level outlet previously described.

g. Seepage or Leakage None

h. Joints - Construction, etc. Joints were in good condition, with no observable erosion, deterioration, spalling or Leakage occurring

i. Foundation Unknown

j. Abutments Not Applicable

k. Control Gates Not Applicable

l. Approach & Outlet Channels See previous description on sheet 5.

m. Energy Dissipators (Plunge Pool, etc.) A 12 step structure for dissipation of flow and masonry chute as previously described.

n. Intake Structures Not Applicable

o. Stability Appears to be stable

p. Miscellaneous None

10) Appurtenant Structures (Powerhouse, Lock, Gatehouse, Other)

a. Description and Condition There are no powerhouse, lock, gatehouse, or other appurtenant structures located at the damsite.

SHEET 9

HYDROLOGIC DATA AND COMPUTATIONS

APPENDIX D

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

	Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1) Top of Dam	487	26.3	177 acre-feet
2) Design High Water (Max. Design Pool)	Unknown	Unknown	Unknown
3) Auxiliary Spillway Crest	Not Applicable (N.A.)	N.A.	N.A.
4) Pool Level with Flashboards	N.A.	N.A.	N.A.
5) Service Spillway Crest	486	24.3	150 acre-ft

DISCHARGES

	Volume (cfs)
1) Average Daily	Unknown
2) Spillway @ Maximum High Water	30 cfs
3) Spillway @ Design High Water	Unknown
4) Spillway @ Auxiliary Spillway Crest Elevation	None
5) Low Level Outlet	Unknown
6) Total (of all facilities) @ Maximum High Water	30+ cfs
7) Maximum Known Flood	Unknown
8) At Time of Inspection	None

CREST: ELEVATION: 486

Type: Stone/Masonry Gravity Structure of Unknown Dimensions

Width: 9.5 feet (Sill) Length: 9.5 feet (sill

Spillover Broad-crested sill

Location 60 feet from left abutment

SPILLWAY:

SERVICE		AUXILIARY
486	Elevation	Not Applicable (N.A.)
Unknown	Type	N.A.
Unknown	Width	N.A.
	Type of Control	
Uncontrolled broad-crested concrete sill	Uncontrolled	N.A.
	Controlled:	
	Type (Flashboards; gate)	N.A
	Number	N.A.
	Size/Length	N A
	Invert Material	N.A.
	Anticipated Length of operating service	N.A
30 feet (±)	Chute Length	N.A.
Not Applicable	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	N.A

HYDROMETEROLOGICAL GAGES:

Type : None

Location: Not Applicable (NA)

Records:

Date - N.A.

Max. Reading - N.A.

FLOOD WATER CONTROL SYSTEM:

Warning System: None

Method of Controlled Releases (mechanisms):

Valve and 24" reservoir drain

DRAINAGE AREA: 0.22 square miles

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Residential

Terrain - Relief: Hilly

Surface - Soil: Glacial Tills

Runoff Potential (existing or planned extensive alterations to existing (surface or subsurface conditions)

Unknown

Potential Sedimentation problem areas (natural or man-made; present or future)

Appear to be none

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

Unknown

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: None

Elevation: Not Applicable

Reservoir:

Length @ Maximum Pool 1600 + feet ~~(Miles)~~

Length of Shoreline (@ Spillway Crest) 1 mile ~~(Miles)~~

TAMS

Job No. 1579-16 Sheet 1 of 23

Project STILL LAKE DAM INSPECTION Date APRIL 6 1981

Subject Hydrologic / Hydraulic Computations. By D.L.C.

Ch'k. by

SNYDERS COEF $640 C_p \sim 375$

$C_T \sim 2.$ $C_p = 0.59$

$L = 1.2" - 2600' = 0.49$ miles

$L_{CA} = .5" \quad 1000 = 0.19$ miles.

$T_p = 2\{(.49)(0.19)\}^{0.3} = .98$ Use $T_p = 0.3333$

$T_{PR} = 0.9811 + 0.250(0.3333 - 0.1784) = 0.9811 + 0.0387 = 1.02$ hrs

FROM HYDROMET 33

All Season 200 sq mile 24hour PMP ~ 22 inches Zone 1

10 sq mile. (point rainfall) percent values.

6 hour	111
12 hour	123
24 hour	133
48 hour	142

INITIAL LOSS 2.0"

CONSTANT LOSS 0.1

LAKE AREA AS % OF D/A = $(2443/140.5) \times 100 = 17\%$

EL	L.B. Distance	R.B. Distance 300ft D/S DAM
500	100	1100
480	270	850
471	420	440
470	430	435

TAMS

Job No. 1579-16 Sheet 2 of 23

Project STILL LAKE DAM INSPECTION Date APRIL 6 1981

Subject HYDRAULIC / HYDROLOGIC COMPUTATIONS By DJC

Ch'k. by

SPILLWAY dimensions

WIDTH 9.5'

HT below arched walkway

at ends 0.5' at center 1.5

MAX Q at 1.0' ≈ 30 cfs.

DAM dimensions

Top of dam elevation 487. C ≈ 3.09. (crest shape)

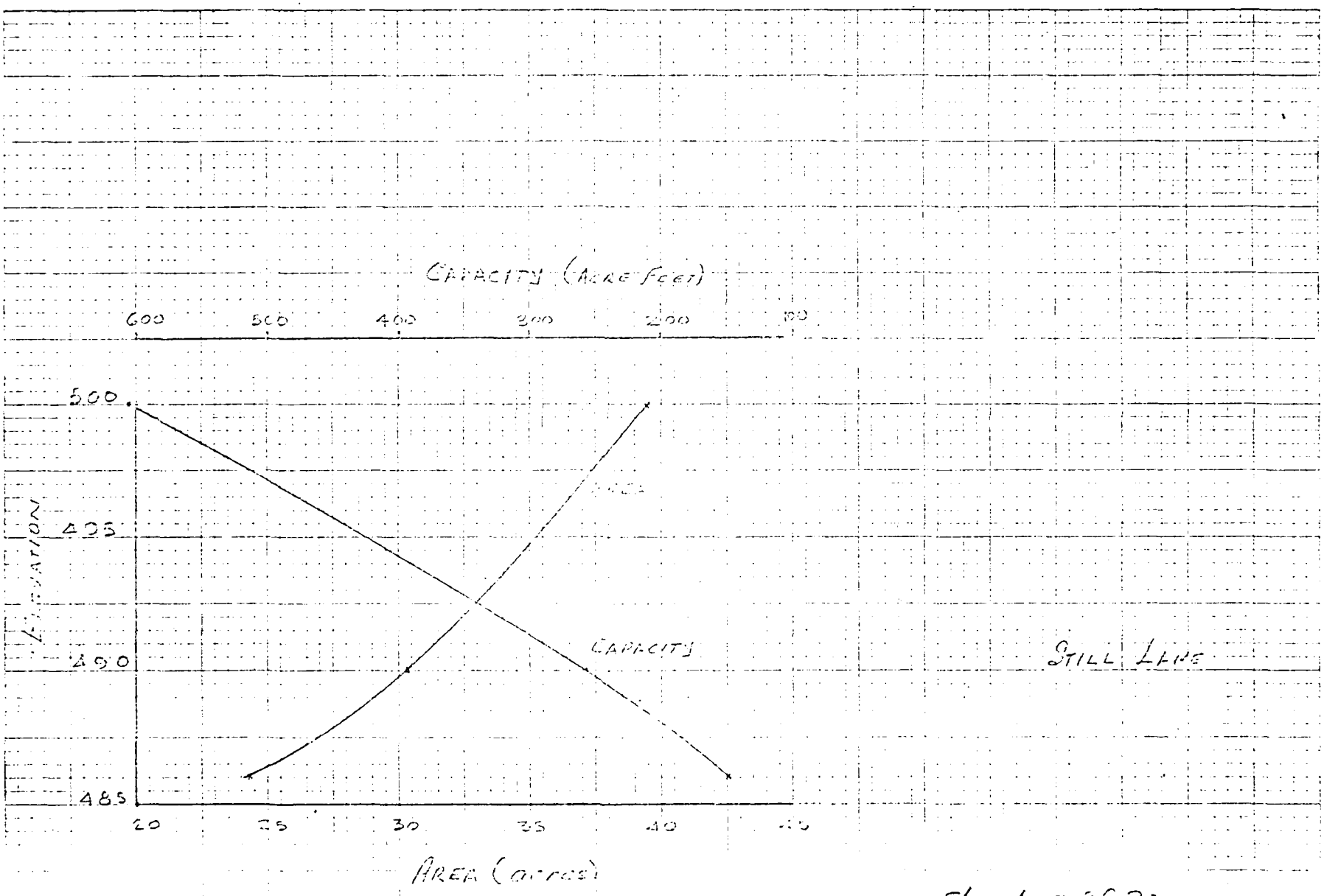
Width 540'

SURCHARGE STORAGE COMPUTATIONS:

EL.	ΔH (FT)	AREA (AC²)	MEAN AREA (AC)	ΔVOLUME (AC FT)	SURCHARGE STORAGE (AC FT)	CAPACITY
486	0	27.3			0	150
	1		27.3	109.2		
490		30.3			109	259
	10.0		31.9	349		
540		39.5			458	608

RATING FOR SPILLWAY - ASSUME WARKWAY IS WASHED OUT.

EL	H	C	Q
486	0		
487	1	3.3	31
488	2	3.3	89
490	4	3.3	251



STILL LAKE

Sheet 3 of 23

TAMS

Job No. 1579-16 Sheet 4 of 23

Project STILL LAKE DAM. Date APRIL 22, 81

Subject HYDROLOGIC/HYDRAULIC COMPUTATIONS By DLC

Ch'k. by

TAIL WATER ELEVATION

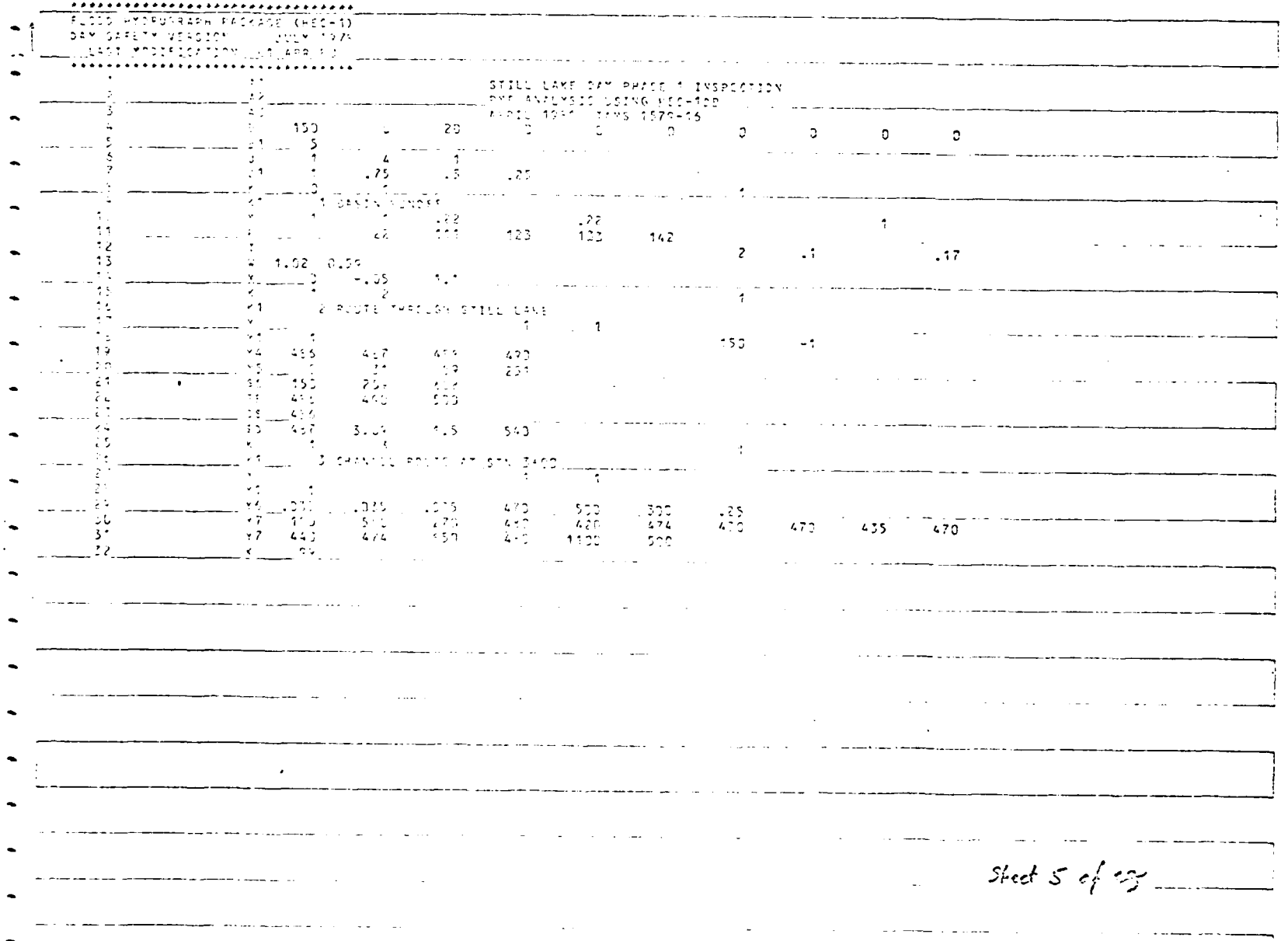
At Section 300 ft Down stream of DAM

Stream invert ~ 470.

max water level ~ 472.4 PMF

471.7 ½ PMF

Assume Water surface slope same as invert slope



PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1
ROUTE HYDROGRAPH TO 2
ROUTE HYDROGRAPH TO 3
END OF NETWORK

Sheet 6 of 25

```
**************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION        JULY 1978
LAST MODIFICATION  01 APR 80
**************************************

RUN  DATE= 81/ /  .
     TIME= 08.3 . .

                          STILL LAKE DAM PHASE 1 INSPECTION
                          PMF ANALYSIS USING HEC-1DB
                          APRIL 1981   IAMS 1579-16

                                JOB SPECIFICATION
         NQ      NHR     NMIN    IDAY     IHR     IMIN    METRC    IPLT    IPRT   NSTAN
        150        0       20       0       0        0        0       0       0       0
                                JOPER     NWT    LROPT    TRACE
                                    5       0        0        0

                     MULTI-PLAN ANALYSES TO BE PERFORMED
                          NPLAN= 1 NRTIO= 4 LRTIO= 1
           RTIOS=   1.00    .75    .50    .25

  **********      **********      **********      **********      **********

                          SUB-AREA RUNOFF COMPUTATION

        1 BASIN RUNOFF

                 ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                     1       0       0       0       0       0       1       0       0

                                  HYDROGRAPH DATA
        IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
            1       1     .22    0.00     .22    0.00   0.000       0       1       0

                                    PRECIP DATA
             SPFE     PMS      R6     R12     R24     R48     R72     R96
             0.00   22.00  111.00  123.00  133.00  142.00    0.00    0.00
 TRSPC COMPUTED BY THE PROGRAM IS  .800

                                     LOSS DATA
       LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
           0    0.00    0.00    1.00    0.00    0.00    1.00    2.00     .10    0.00     .17

                           UNIT HYDROGRAPH DATA
                       TP= 1.02     CP= .59     NTA= 0

                              RECESSION DATA
                    STRTQ=   0.00    QRCSN=   -.05    RTIOR= 1.10
 APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.70 AND R= 2.4  INTERVALS

          UNIT HYDROGRAPH 18 END-OF-PERIOD ORDINATES, LAG=  1.02 HOURS, CP= .59  VOL= 1.00
       12.     144.     74.     72.     57.     45.     32.     22.     15.     11.
        8.       6.      4.      3.      2.      1.      1.      1.
```


Sheet 7 of 23

Sheet 8 of 24

1.01	19.80	57	.00	.00	.00	5.	1.02	20.00	132	.06	.03	.03	103.
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1.01	19.80	60	.00	.00	.00	1.	1.02	20.00	135	.06	.03	.03	44.
1.01	20.00	61	.00	.00	.00	1.	1.02	20.00	136	.06	.03	.03	36.
1.01	20.40	62	.00	.00	.00	1.	1.02	20.40	137	.06	.03	.03	36.
1.01	20.40	63	.00	.00	.00	1.	1.02	20.40	138	.06	.03	.03	36.
1.01	21.60	64	.00	.00	.00	1.	1.02	22.00	139	.06	.03	.03	35.
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1.01	21.60	66	.00	.00	.00	0.	1.02	22.00	141	.06	.03	.03	35.
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1.02	1.00	75	.04	.01	.00	1.	1.03	2.00	150	0.00	0.00	0.00	32.

SUM 24.99 21.63 3.35 9456.
(635.)(550.)(85.)(267.75)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	720.	413.	129.	63.	9440.
CMS	21.	12.	4.	2.	267.
INCHES		17.44	21.69	22.18	22.18
MM		443.09	556.10	563.27	563.27
AC-FT		235.	257.	260.	260.
THOUS CU M		253.	317.	321.	321.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	2.
2.	3.	3.	3.	4.	4.	5.	7.	8.	9.
8.	7.	6.	5.	5.	4.	3.	2.	2.	1.
1.	1.	1.	1.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	2.	2.	2.	2.	3.
3.	3.	3.	3.	3.	4.	4.	4.	4.	5.
6.	9.	15.	21.	24.	30.	32.	34.	35.	36.
37.	37.	37.	38.	38.	39.	39.	39.	48.	68.
107.	151.	191.	224.	254.	283.	312.	346.	435.	587.
718.	729.	656.	575.	506.	456.	397.	335.	263.	194.
141.	103.	75.	57.	44.	36.	36.	35.	35.	35.
35.	34.	34.	34.	33.	33.	33.	32.	32.	32.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	729.	413.	129.	63.	9440.
CMS	21.	12.	4.	2.	267.
INCHES		17.44	21.69	22.18	22.18
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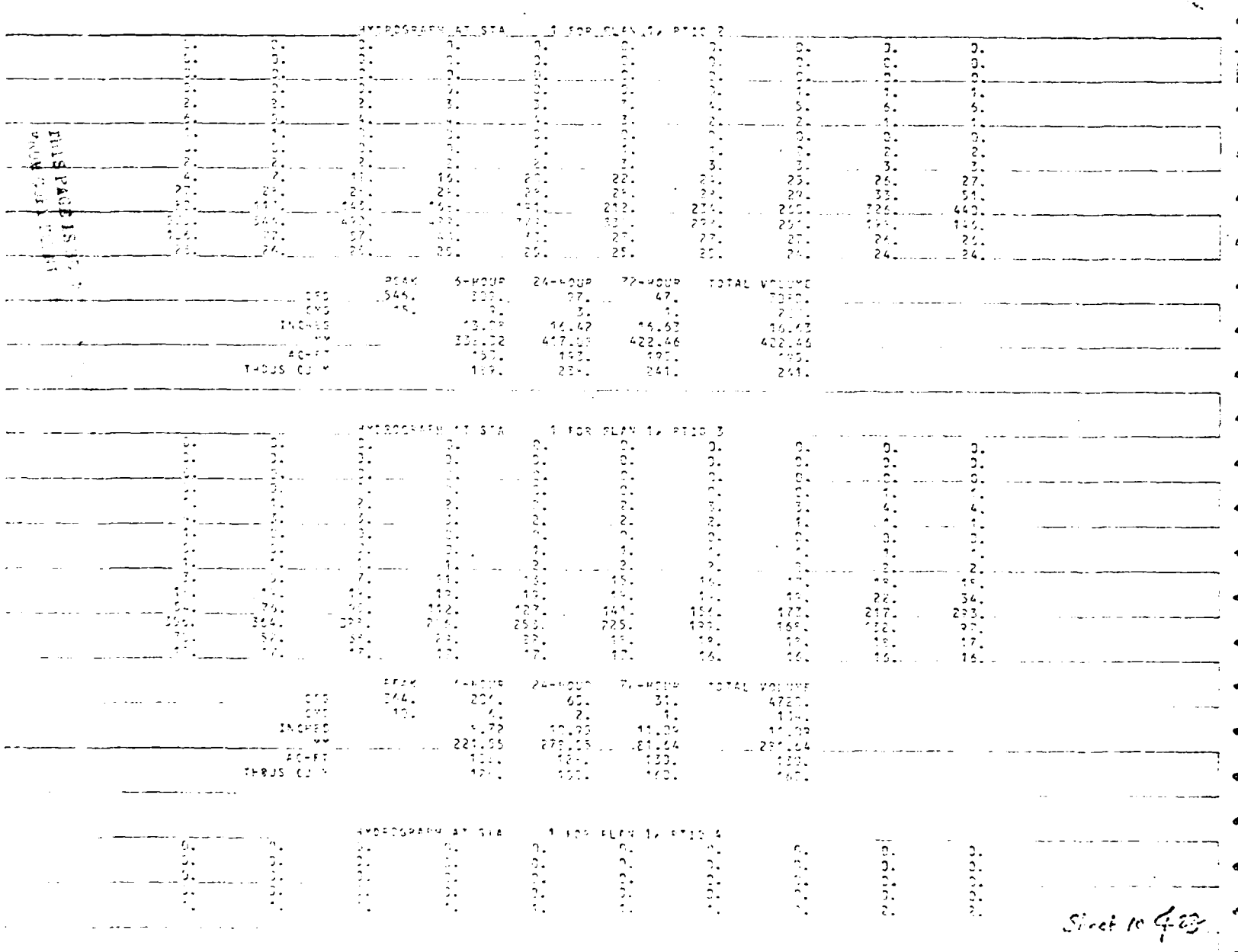
AC-FT		235.	257.	260.	260.
THOUS CU M		253.	317.	321.	321.



Sheet 10 of 23

Sheet 11 of 23

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0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	1.	1.	1.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
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9.	10.	11.	11.	12.	13.	14.	15.	15.	17.
19.	22.	27.	45.	162.	242.	234.	322.	330.	496.
640.	719.	673.	567.	544.	487.	470.	374.	311.	244.
155.	140.	107.	[illegible]	65.	57.	45.	41.	39.	39.
37.	35.	36.	35.	35.	34.	34.	34.	33.	33.

STORAGE

150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
[illegible]	150.	[illegible]	150.	150.	150.	150.	150.	150.	150.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	151.	151.
152.	152.	152.	[illegible]	152.	152.	152.	152.	152.	152.
152.	152.	152.	152.	151.	152.	152.	152.	152.	152.
152.	152.	152.	151.	151.	151.	151.	151.	151.	151.
152.	152.	152.	152.	152.	152.	152.	152.	152.	152.
152.	152.	152.	153.	153.	154.	155.	155.	156.	157.
157.	159.	164.	169.	161.	161.	162.	163.	163.	165.
167.	170.	174.	171.	182.	184.	185.	185.	186.	185.
181.	182.	182.	190.	[illegible]	187.	187.	186.	185.	184.
[illegible]	181.	[illegible]	180.	179.	179.	179.	173.	175.	179.
175.	174.	173.	[illegible]	[illegible]	176.	[illegible]	175.	175.	175.

STAGE

456.0	456.0	456.0	456.0	456.0	456.0	456.0	456.0	455.0	455.0
456.0	455.0	455.0	456.0	455.0	456.0	456.0	456.0	455.0	455.0
456.1	455.0	455.0	456.0	456.0	455.0	456.0	456.0	455.0	455.0
456.0	456.0	456.0	456.0	456.0	455.0	456.0	456.0	455.0	455.0
456.0	456.0	456.0	456.0	456.0	456.0	456.0	456.0	455.0	455.0
455.1	455.1	456.1	456.1	456.1	455.1	456.1	456.1	455.1	455.1
456.1	456.1	457.1	456.1	456.1	456.1	456.1	456.1	455.1	455.1
456.1	456.1	457.1	456.1	456.1	456.1	456.1	456.1	455.1	455.1
456.1	456.1	456.1	456.1	456.1	456.1	456.1	456.1	455.1	456.1
456.1	455.1	456.1	455.1	455.1	456.1	456.2	456.2	455.2	455.3
456.3	456.3	456.3	456.4	455.4	456.4	456.4	456.5	455.5	455.5
456.6	455.7	457.0	457.0	457.2	457.2	457.3	457.3	457.3	457.4
457.5	457.5	457.5	457.5	457.4	457.4	457.3	457.3	457.3	457.2
457.2	457.2	457.1	457.1	457.1	457.0	457.0	457.0	457.0	457.0
457.0	457.0	457.0	457.0	457.0	457.0	457.0	457.0	457.0	457.0

PEAK OUTFLOW IS 719. AT TIME 40.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	719.	402.	116.	56.	[illegible]
CMS	20.	11.	3.	2.	[illegible]
INCHES		17.0[illegible]	19.6[illegible]	[illegible]	[illegible]
MM		432.[illegible]	[illegible]	503.91	[illegible]
AC-FT		[illegible]	[illegible]	[illegible]	[illegible]
THOUS CU M		246.	[illegible]	257.	[illegible]

Sheet 120 of 23[illegible]

STATION 2, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	[illegible]	[illegible]	[illegible]	1.	[illegible]	[illegible]	1.	[illegible]
1.	1.	2.	2.	[illegible]	2.	2.	[illegible]	2.	2.
2.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.
[illegible]	[illegible]	[illegible]	1.	[illegible]	1.	[illegible]	[illegible]	1.	1.
1.	1.	1.	1.	1.	1.	1.	2.	2.	2.
2.	2.	2.	2.	3.	3.	[illegible]	2.	5.	6.
7.	7.	[illegible]	9.	9.	10.	[illegible]	11.	12.	12.
14.	[illegible]	23.	[illegible]	[illegible]	[illegible]	173.	[illegible]	250.	355.
473.	535.	[illegible]	455.	[illegible]	365.	325.	[illegible]	236.	137.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	32.	31.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30.	30.	[illegible]

STORAGE

150.	150.	150.	150.	[illegible]	150.	150.	150.	150.	150.
150.	150.	150.	150.	[illegible]	150.	150.	150.	150.	150.
150.	150.	150.	150.	[illegible]	150.	150.	150.	150.	150.
150.	150.	150.	151.	[illegible]	150.	[illegible]	150.	150.	150.
150.	150.	150.	150.	[illegible]	151.	[illegible]	[illegible]	[illegible]	151.
151.	151.	151.	151.	[illegible]	152.	152.	[illegible]	152.	152.
151.	151.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	151.	151.
151.	151.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	151.
[illegible]	151.	151.	151.	151.	[illegible]	[illegible]	[illegible]	151.	151.
151.	152.	152.	152.	[illegible]	152.	[illegible]	[illegible]	155.	155.
155.	155.	157.	[illegible]	[illegible]	[illegible]	[illegible]	160.	160.	161.
162.	165.	[illegible]	171.	176.	[illegible]	[illegible]	[illegible]	[illegible]	136.
[illegible]	179.	179.	[illegible]	[illegible]	[illegible]	[illegible]	135.	[illegible]	133.
[illegible]	181.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	177.	177.
177.	177.	177.	177.	[illegible]	[illegible]	[illegible]	[illegible]	176.	176.

STAGE

486.0	486.0	486.0	486.0	486.0	486.0	486.0	486.0	485.0	485.0
486.0	486.0	486.0	486.0	486.0	486.0	486.0	486.0	485.0	485.0
486.0	486.0	486.0	486.0	486.0	486.0	486.0	486.0	485.0	485.0
486.0	486.0	486.0	486.0	486.0	486.0	486.0	486.0	485.0	485.0
486.0	486.0	486.0	[illegible]	486.0	[illegible]	[illegible]	486.0	486.0	486.0
486.0	486.0	486.0	[illegible]	486.1	[illegible]	[illegible]	486.1	486.1	485.1
486.1	486.1	486.1	[illegible]	[illegible]	[illegible]	[illegible]	486.0	485.0	485.0
486.0	486.0	486.0	486.0	486.0	486.0	[illegible]	486.0	485.0	485.0
486.0	486.0	486.0	486.0	486.0	486.0	486.0	[illegible]	486.1	486.1
486.1	486.1	485.1	486.1	486.1	486.1	486.1	486.2	486.2	486.2
486.2	486.2	486.3	486.3	486.3	486.3	486.3	486.4	485.4	485.4
486.5	486.5	486.6	486.9	486.9	487.1	487.2	487.2	487.3	487.3
487.4	487.4	487.4	487.4	487.4	487.3	487.3	487.3	487.2	487.2
487.2	487.1	487.1	487.1	487.0	487.0	487.0	487.0	487.0	487.0
487.0	487.0	487.0	487.0	487.0	487.0	487.0	487.0	487.0	485.9

PEAK OUTFLOW IS 535. AT TIME 40.67 HOURS

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

CFS	335.	232.	85.	41.	5742.
CMS	[illegible]	[illegible]	2.	1.	174.
INCHES		12.75	14.31	14.43	14.43
MM		[illegible]	363.44	366.46	366.46
AC-FT		14[illegible].	169.	169.	169.
THOUS CU M		17[illegible].	207.	209.	209.

STATION 2, PLAN 1, RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	2.	2.	2.	3.	3.	4.	4.
4.	5.	5.	6.	[illegible]	6.	7.	7.	8.	8.
[illegible]	11.	13.	16.	[illegible]	23.	27.	3[illegible].	112.	214.
[illegible]	[illegible]	347.	31[illegible].	277.	247.	21[illegible].	172.	151.	129.
1[illegible].	77.	[illegible]	47.	38.	33.	31.	30.	30.	30.
2[illegible].	[illegible]	[illegible]	2[illegible].	2[illegible].	27.	[illegible]	27.	26.	26.

STORAGE

150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	151.	151.
151.	151.	151.	151.	151.	151.	151.	151.	151.	151.
151.	151.	151.	151.	151.	151.	151.	151.	151.	151.
151.	151.	151.	151.	151.	151.	151.	151.	151.	151.
151.	151.	151.	151.	151.	151.	151.	151.	151.	151.
151.	151.	151.	151.	152.	152.	152.	153.	153.	154.
154.	154.	155.	155.	155.	156.	156.	156.	157.	157.
1[illegible].	1[illegible].	1[illegible].	[illegible]	167.	17[illegible].	[illegible]	177.	1[illegible].	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1[illegible]3.	[illegible]	[illegible]
[illegible]	[illegible]	17[illegible].	[illegible]	17[illegible].	1[illegible]7.	[illegible]	1[illegible]7.	176.	176.
17[illegible].	175.	175.	[illegible]	174.	174.	[illegible]	174.	173.	173.

STAGE

4[illegible].0	4[illegible].0	4[illegible].0	485.0	485.0	485.0	485.0	485.0	485.0	485.0
485.0	485.0	485.0	485.0	485.0	48[illegible].0	4[illegible].0	485.0	485.0	485.0
485.0	[illegible]	4[illegible].0	485.0	485.0	[illegible]	[illegible]	485.0	485.0	485.0
[illegible]	485.0	4[illegible].0	485.0	485.0	48[illegible].0	4[illegible].0	485.0	485.0	485.0
[illegible]	485.0	[illegible]	[illegible]	485.0	[illegible]	[illegible]	485.0	485.0	485.0
485.0	485.0	[illegible]	485.0	[illegible]	485.0	[illegible]	[illegible]	485.0	485.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	485.0	485.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	485.0	[illegible]
[illegible]	485.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	485.0	[illegible]
485.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4[illegible].1	485.1	[illegible]
485.1	[illegible]	[illegible]	485.2	485.2	[illegible]	4[illegible].2	4[illegible].2	485.2	485.3
4[illegible].3	4[illegible].4	4[illegible].4	485.5	4[illegible].6	4[illegible].7	4[illegible].9	4[illegible]7.0	4[illegible]7.1	4[illegible]7.2

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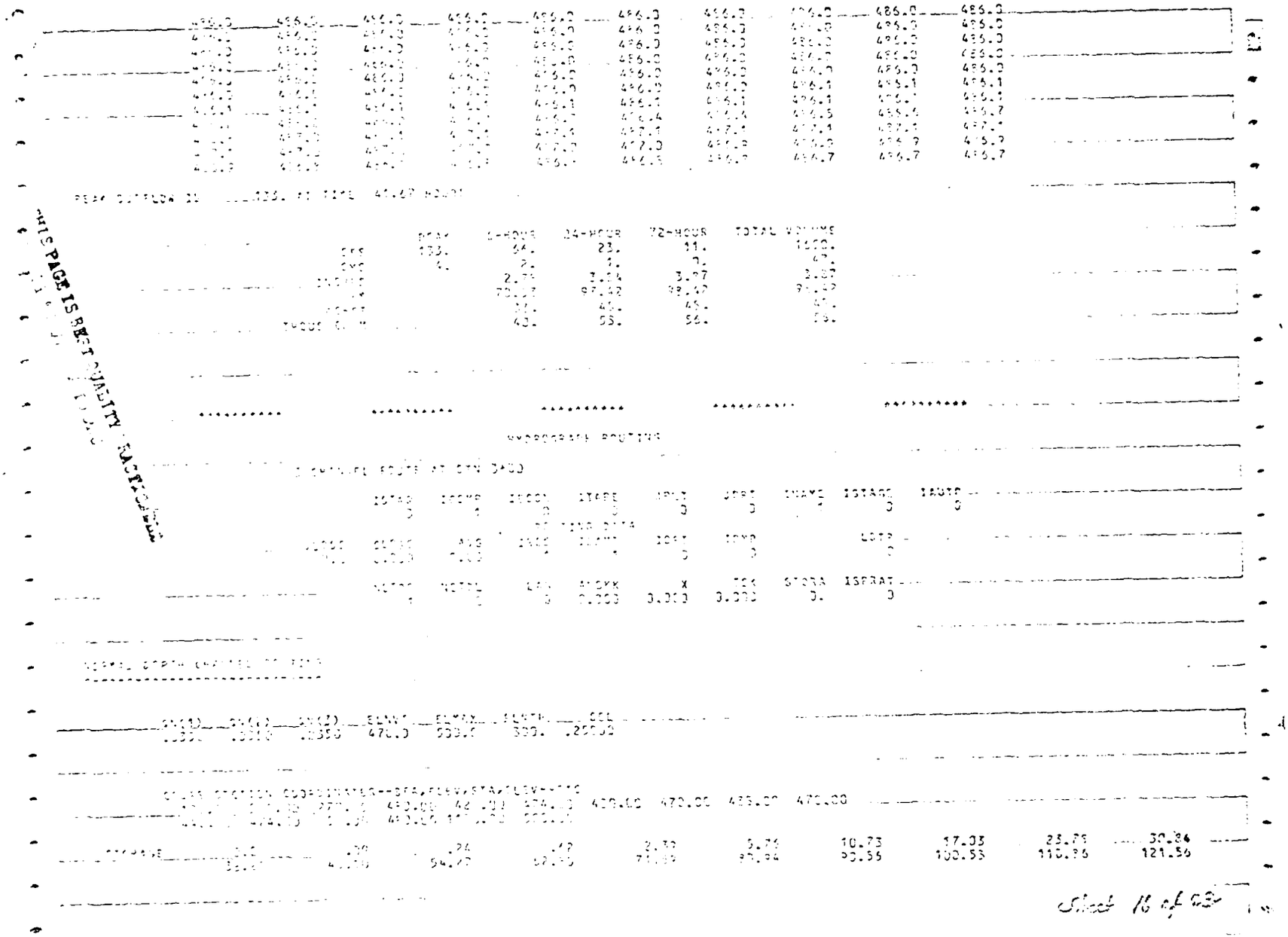

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0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0
470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0
470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0
470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0
470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0
470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0
470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0
470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0
470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0
470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0
470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0	470.0
470.0	470.0	470.0	470.0	470.1	470.1	470.1	470.1	470.1	470.1
470.1	470.2	470.5	470.7	470.8	470.7	470.5	470.6	470.5	470.4
470.3	470.3	470.2	470.2	470.2	470.2	470.2	470.2	470.2	470.2
470.2	470.1	470.1	470.1	470.1	470.1	470.1	470.1	470.1	470.1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	133.	56.	23.	11.	1649.
CMS	4.	2.	1.	0.	47.
INCHES		2.78	3.83	3.87	3.87
MM		70.57	97.40	98.41	98.41
AC-FT		33.	45.	45.	45.
THOUS CU M		40.	55.	56.	56.

MAXIMUM STORAGE = 0.

MAXIMUM STAGE IS 470.8

....

Sheet 21 of 23

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 1.00	RATIO 2 .75	RATIO 3 .50	RATIO 4 .25
				RATIOS APPLIED TO FLOWS			
HYDROGRAPH AT	1	.22	1	[illegible]	547.	364.	[illegible]
	(	.57)	(	20.6[illegible]) (	15.47) (	10.3[illegible]) (	5.[illegible]) (
ROUTED TO	2	.22	1	[illegible]	[illegible]	[illegible]	133.
	(	.57)	(	20.35) (	15.[illegible]4) (	9.34) (	[illegible].77) (
ROUTED TO	3	.22	1	[illegible]	[illegible]	352.	[illegible]
	(	.57)	(	[illegible]) (	15.[illegible]) (	[illegible]) (	3.76) (

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	4[illegible].00	486.00	487.00
STORAGE	150.	[illegible]	177.
OUTFLOW	0.	0.	31.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	4[illegible]7.5[illegible]	.5[illegible]	1[illegible]2.	719.	17.[illegible]	40.67	0.00
.75	487.45	.[illegible]	[illegible]	535.	[illegible]	40.67	0.00
.50	487.32	.32	[illegible].	33[illegible].	6.[illegible]	40.67	0.00
.25	487.15	.15	[illegible]1.	133.	4.[illegible]0	41.67	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	719.	472.4	40.67
.75	535.	472.1	40.67
.50	332.	471.7	40.[illegible]
.25	133.	[illegible].3	41.[illegible]

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STABILITY ANALYSIS

APPENDIX E

TAMS

Job No. 1579-16 Sheet 1 of 17
Project Still Lake Dam : Phase I Inspection Date 22 Apr. 81
Subject Stability Analysis : Loading Conditions and Analysis Criteria By A. D.
Ch'k. by JP

LOADING CONDITIONS

Case	Description
I	Normal Loading - Lake Level at Overflow Section Crest Elevation (El. 486)
II	Normal Loading, as in Case I, with an additional Ice Loading of 5 Kips/L.F. at 0.5 feet below crest.
III	Unusual Loading, Lake Level at ½ PMF (El 487.32)
IV	Extreme Loading, Lake Level at Full PMF (EL 487.52)
V	Unusual Loading, Lake Level as in Case I, with additional Earthquake loadings for Zone 2 criterion (n = 0.05)

STABILITY AND OVERTURNING CRITERIA

Case	Location of Resultant	Shear Friction Factor of Safety
I	middle third	> 3.0
II	middle third	> 3.0
III	middle third	> 3.0
IV	middle third	> 3.0
V	within base	> 1.5

TAMS

Job No. 1579-16 Sheet 2 of 17

Project Still Lake Dam: Phase I Inspection Date 22 April 81

Subject Stability Analysis: Assumed Geometric and Material Properties By A.D

Ch'k. by

ASSUMED GEOMETRY AND MATERIAL PROPERTIES

1. The configuration of the spillway section is, as shown, on Figure 1. For stability, the d/s face of the gravity structure was assumed to be 0.7H to 1V

2. The upstream earth buttress was assumed to have a 1V:6H slope to a distance of 15 ft from the dam and a 1V:1H slope thereafter. (See configuration for Case II)

3. The dam was assumed to be founded on a soil foundation. The shearing resistance between the soil and gravity base is $\tan\phi$, and ϕ was assumed to be 25° with a $c = 1$ ksf.

4. The unit weights of the materials were assumed, as follows:

   Stone / Masonry: $2.4\gamma_w$ or 150 lbs/ft³

   Saturated Earth Backfill: $2\gamma_w$ or 125 lbs/ft³

   Also, the lateral earth pressure coefficient was assumed to be 0.5 for the upstream earth buttress. No passive resistance was assumed at the toe.

5. The arched concrete structure above the overflow crest was excluded from this analysis.

6. Refer to Figure 1 for Assumed Typical Cross Section and Assumed Values of Material Properties

7. Stability analyses & criteria in accordance with Corps of Engrs. recommended guidelines

TAMS

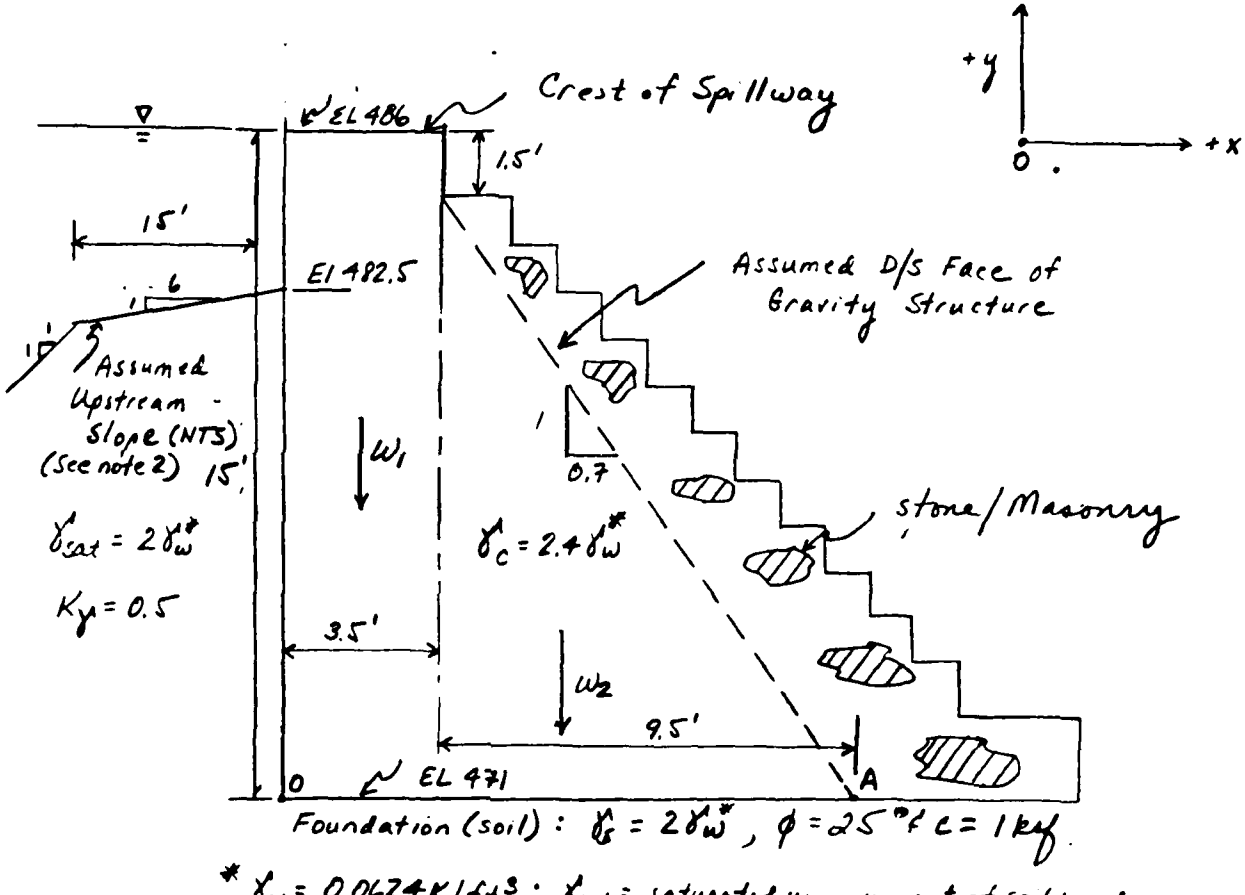
Job No. 1579-16 Sheet 3 of 17

Project Still Lake Dam : Phase I Inspection Date 22 April 81

Subject Stability Analysis By A.D.

Ch'k. by

ASSUMED TYPICAL CROSS-SECTION OF OVERFLOW SECTION



* $\gamma_w = 0.0624$ K/ft^3; γ_{sat} = saturated unit weight of soil; and γ_c = unit weight of concrete

SCALE 1 inch = 4 feet

0 2 4 6 8 feet

Figure 1

NTS = Not to Scale (where stated)

TAMS

Job No. 1579-16 Sheet 4 of 17

Project Still Lake Dam : Phase I Inspection Date 22 April 1981

Subject Stability Analysis By A.D.

Ch'k. by

COMPUTATION OF STRUCTURE CENTER OF GRAVITY (C of G)

—— Weight Computations ——

Section	F' (1)	F_γ (2)	B	H	$F'FBH\gamma_w$	
W_1	1.0	2.4	3.5	15	$126\ \gamma_w$	Total Weight = $278.3\gamma_w$ K/LF
W_2	0.5	2.4	9.4	13.5	$152.3\ \gamma_w$	
	—					

note: (1) F' is a geometric factor, i.e for a triangle $F' = 0.5$, for a rectangle $F' = 1.0$

(2) F_γ is a coefficient multiplied by γ_w (62.4 pcf) to obtain unit weight

Determine Moment Weights About Point O:

(a) $$\bar{x} = \frac{W_1 x_1 + W_2 x_2}{W_1 + W_2 + W_3}$$ where x_i = distance to C. of G. of Section in x-direction

$$= \frac{126\gamma_w\left(\frac{3.5}{2}\right) + 152.3\gamma_w\left(3.5 + \frac{9.5}{3}\right)}{126\gamma_w + 152.3\gamma_w + 0}$$

$$\bar{x} = 4.44 \text{ feet}$$

(b) $$\bar{y} = \frac{W_1 y_1 + W_2 y_2 + W_3 y_3}{W_1 + W_2}$$ where y_i = distance to C of G of Section in y-direction.

$$\bar{y} = \frac{126\gamma_w\left(\frac{15}{2}\right) + 152.3\gamma_w\left(\frac{15-1.5}{2}\right)}{126\gamma_w + 152.3\gamma_w + 0}$$

$$\bar{y} = 5.86 \text{ feet}$$

TAMS

Job No. 1579-16 Sheet 5 of 17

Project Still Lake Dam : Phase I Inspection Date 22 April 81

Subject Stability Analyses : Normal Loading Condition (Lake level at Spillway Crest) By A.D.

Ch'k. by

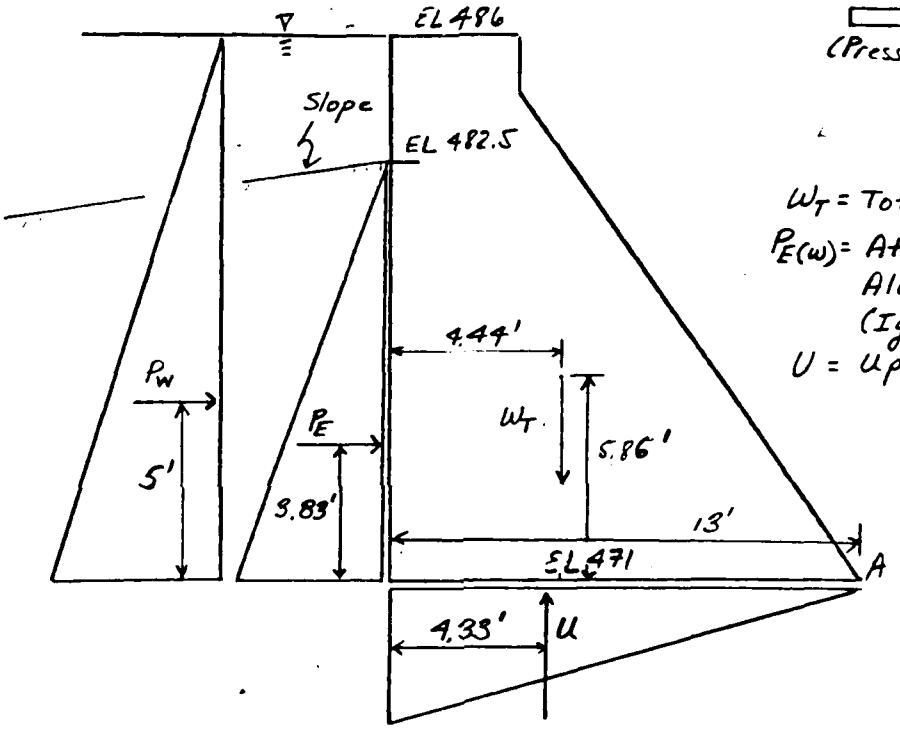
CASE 1 : NORMAL LOADING CONDITION (Lake Level at Spillway Crest)

ASSUMED TYPICAL CROSS SECTION

SCALE : 1 inch = 5 feet

0 2 4 6 8 10 ft

(Pressure Distributions Not to Scale)



Definitions

W_T = Total Weight of Structure

$P_{E(W)}$ = At-Rest Earth (Water) Force Along Upstream Face (Ignore Effects of 1V:6H slope)

U = Uplift Force Beneath Spillway

Forces (Kips/LF)	Moment About A (Kip-Feet/LF)
$P_W = 0.5(486-471)^2 \gamma_w =$ $112.5\gamma_w \rightarrow$	$\overset{\curvearrowright}{P_W} = (112.5\gamma_w)(5) =$ $562.5\gamma_w \curvearrowright$
$P_E = 0.5(482.5-471)^2(\gamma_{sat}-\gamma_w) =$ $66.1\gamma_w \rightarrow$	$\overset{\curvearrowright}{P_E} = (66.1\gamma_w)(3.83) =$ $253.2\gamma_w \curvearrowright$
$\Sigma F_H :$ $= 178.6\gamma_w \rightarrow$	
$W_T =$ $278.3\gamma_w \downarrow$	$\overset{\curvearrowleft}{W_T} = 278.3\gamma_w(13-4.44) =$ $2382.2\gamma_w \curvearrowleft$
$U = 0.5(13)(486-471)\gamma_w =$ $97.5\gamma_w \uparrow$	$\overset{\curvearrowleft}{U} = 97.5\gamma_w(13-4.33) =$ $845.3\gamma_w \curvearrowleft$
$\Sigma F_V :$ $= 180.8\gamma_w \downarrow$	

TAMS

Job No. 1579-16 Sheet 6 of 17

Project Still Lake Dam - Phase I Inspection Date 22 April 81

Subject Stability Analysis - Normal Loading Condition (Lake Level at Spillway Crest) By A.D

Ch'k. by

From Previous Table:

$\Sigma F_H = 178.6\,\gamma_w \rightarrow$ (K/LF)

$\Sigma F_V = 180.8\,\gamma_w \downarrow$ (K/LF)

$\Sigma M_{resisting} = \overleftarrow{W_T} = 2382.2\,\gamma_w \circlearrowleft$ (K-Ft/LF)

$\Sigma M_{opposing} = \overrightarrow{P_w} + \overrightarrow{P_E} + \overrightarrow{U} = 1,661\,\gamma_w \circlearrowright$ (K-Ft/LF)

$\Sigma(M_r - M_o)^* = 721.2\,\gamma_w$

* $\Sigma M_{resisting} = \Sigma M_r$

* $\Sigma M_{opposing} = \Sigma M_o$

Location of Resultant at Base

$$\bar{X}_{result} = \frac{\Sigma(M_r - M_o)}{\Sigma F_V} - \frac{B}{3} = \frac{721.2\,\gamma_w}{180.8\,\gamma_w} - \frac{13}{3}$$

$\bar{X}_{result} = -0.34$ feet outside middle third.

Shear Friction Factor of Safety:

$$S.F.F.S. = \frac{\Sigma F_V \tan\phi + cA}{\Sigma F_H} = \frac{(180.8\,\gamma_w)\tan 25 + 1(13)}{178.6\,\gamma_w}$$

$S.F.F.S. = 1.63 < 3.0$ (No Good)

TAMS

Job No. 1579-16 Sheet 7 of 17

Project Still Lake Dam : Phase I Inspection Date 22 April 81

Subject Stability Analyses : Normal Loading (Lake level at Spillway Crest) with Ice Load By A.D.

Ch'k. by

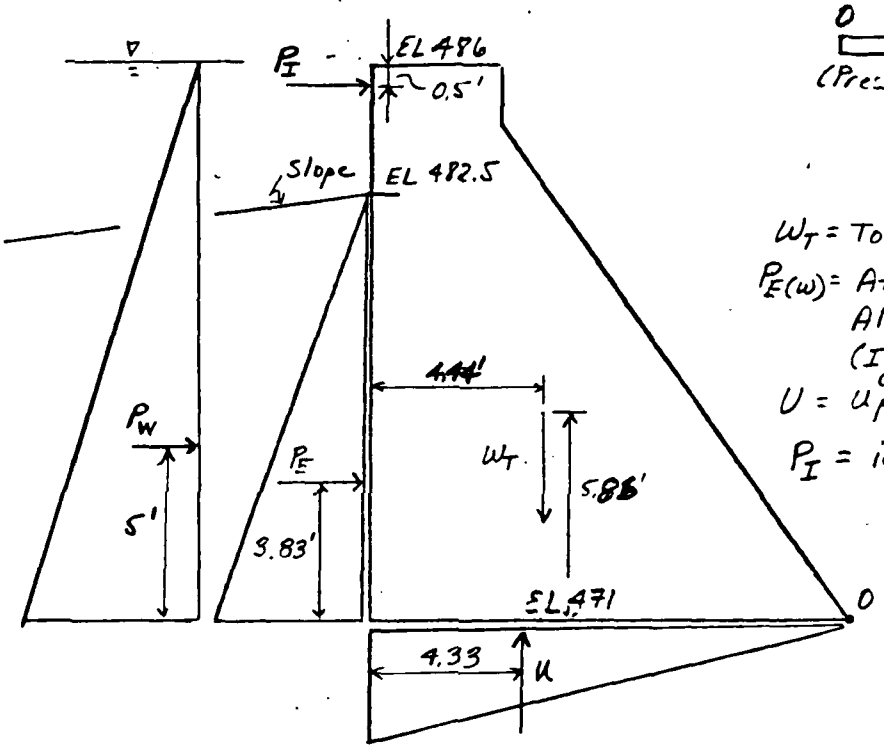
CASE II - NORMAL LOADING (Lake Level at Spillway crest) WITH ICE LOAD

ASSUMED TYPICAL CROSS SECTION

SCALE : 1 inch = 5 feet

0 2 4 6 8 10 ft

(Pressure Distributions Not to Scale)



Definition:

W_T = Total Weight of Structure

$P_{E(W)}$ = At-Rest Earth (Water) Force Along Upstream Face (Ignore Effects of 1V:6H slope)

U = Uplift Force Beneath Spillway

P_I = ice load = 5,000 lbs/L.F. OR $80.13\gamma_w$

	Force (Kips/LF.)	Moment About O (Kip-Feet/L.F.)
P_I =	5 Kips/LF.	$\overrightarrow{P_I} = 80.13\gamma_w \times (486 - 0.5 - 471) =$ $1161.9\gamma_w$

From Page 6 of 17, the summation of forces and moments follows:

$\Sigma F_H = \overrightarrow{\Sigma F_H}$ (pg 6 of 17) $+ \overrightarrow{P_I} = 178.6\gamma_w + 80.13\gamma_w = 258.7\gamma_w$ (K/LF)

$\Sigma F_V = \Sigma F_V \downarrow$ (pg 6 of 17) $= 180.8\gamma_w \downarrow$ (K/LF)

$\Sigma M_{resisting} = \overleftarrow{\Sigma M_{resisting_O}}$ (pg 6 of 17) $= 2,382\ \gamma_w \circlearrowleft$ (K-ft/LF)

$\Sigma M_{opposing} = \Sigma M_{opposing}$ (pg 6 of 17) $+ \overrightarrow{P_I} = 2,823\ \gamma_w \circlearrowright$ (K-ft/LF)

TAMS

Job No. 1579-16 Sheet 8 of 17

Project Still Lake Dam : Phase I Inspection Date 22 April 81

Subject Stability Analysis : Normal Loading (Lake Level at Spillway Crest) with Ice Loads By AD

Ch'k. by

Resultant Location :

$$\bar{X}_{result} = \frac{\Sigma(M_r - M_o)}{\Sigma F_V} - \frac{B}{3}$$

$$= \frac{(2382 - 2823)\gamma_w}{180.8\gamma_w} - \frac{13}{3}$$

$$\bar{X}_{result} = -6.77 \text{ feet (outside middle third)}$$

Shear Friction Factor of Safety :

$$SFFS = \frac{\Sigma F_V \tan\phi + cA}{\Sigma F_H} = \frac{180.8\gamma_w \tan 25° + 1(13)}{258.7\gamma_w}$$

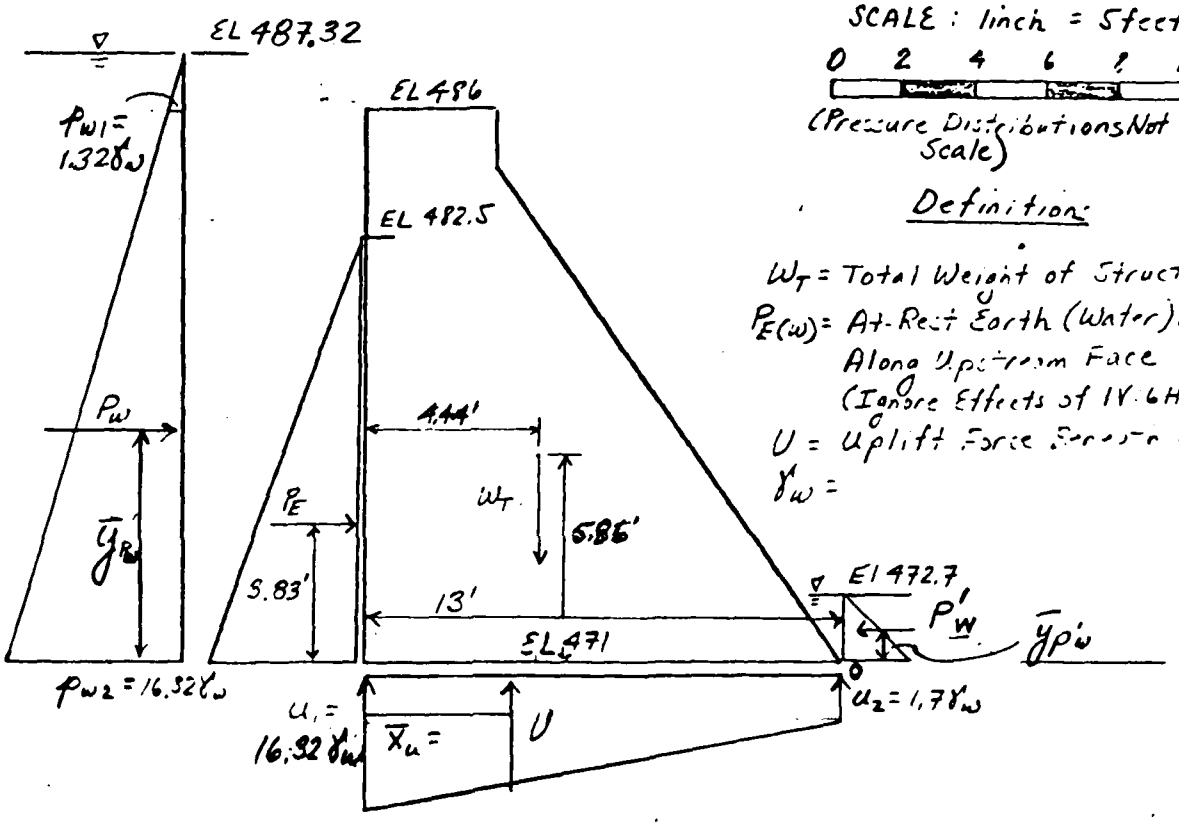
$$= 1.13 < 3.0 \text{ (No Good)}$$

TAMS

Job No. 1579-16 Sheet 9 of 17
Project Still Lake Dam : Phase I Inspection Date 22 April 81
Subject Stability Analyses : Unusual Loading (½ PMF) By A.D.
Ch'k. by

CASE III : UNUSUAL LOADING (½ PMF)

ASSUMED TYPICAL CROSS SECTION
SCALE : 1 inch = 5 feet
0 2 4 6 8 10 ft
(Pressure Distributions Not to Scale)



Definition:

W_T = Total Weight of Structure
$P_{E(w)}$ = At-Rest Earth (Water) Force Along Upstream Face (Ignore Effects of 1V:6H slope)
U = Uplift Force Across Dam
γ_w =

Determine Uplift Force, Location ($\bar{x}_u$) and Moment:

Force:

$u_1 = (487.32 - 471)\gamma_w = 16.32\,\gamma_w$

$u_2 = (472.7 - 471)\gamma_w = 1.7\,\gamma_w$

$$U = \left\{\frac{u_1 + u_2}{2}\right\}(13) = 117.1\,\gamma_w \uparrow (K/LF)$$

Location:

$$\bar{x}_u = \frac{1.7\gamma_w\left(\frac{13^2}{2}\right) + \frac{\gamma_w}{2}(16.32 - 1.7)\left(\frac{13}{3}\right)^2}{(1.7)13\gamma_w + (16.32 - 1.7)\frac{1}{2}(13)\gamma_w} = \frac{555.4\,\gamma_w}{117.1\,\gamma_w}$$

$$\bar{x}_u = 4.74 \text{ feet}$$

TAMS

Job No. 1579-16 Sheet 10 of 17
Project Still Lake Dam: Phase I Inspection Date 22 April 81
Subject Stability Analysis: Unusual Loading (½ PMF) By A.D
Ch'k. by

Determine P_w Force, Location ($\bar{y}_{pw}$) and Moment:

Force:

$$p_{w1} = \gamma_w (487.32 - 486) = 1.32\gamma_w$$

$$p_{w2} = \gamma_w (487.32 - 471) = 16.32\gamma_w$$

$$P_w = \left\{ \frac{1.32\gamma_w + 16.32\gamma_w}{2} \right\} (486 - 471)$$

$$P_w = 132.3\ \gamma_w \rightarrow (K/LF)$$

Location:

$$\bar{y}_{pw} = \frac{\gamma_w (486-471)\left\{ 1.32\frac{(486-471)}{2} + \frac{1}{2}(16.32-1.32)\frac{(486-471)}{3} \right\}}{\gamma_w (486-471)\left\{ (1.32) + \frac{1}{2}(16.32-1.32) \right\}}$$

$$\bar{y}_{Pw} = 5.37 \text{ feet}$$

Moment: $P_w \times \bar{y}_{pw} = 710.5\gamma_w \curvearrowleft$ (K-ft/LF)

Determine P'_w Force, Location ($\bar{y}_{p'w}$) and Moment $\overleftarrow{P'_w}$:

Force:

$$P'_w = 0.6\left\{ (0.5)(472.7 - 471)^2 \gamma_w \right\}$$

$$P_w' = 0.87\gamma_w \leftarrow (K/LF)$$

Location:

$$\bar{y}_{p'w} = \frac{1}{3}(472.7 - 471)$$

$$y_{p'w} = 0.57 \text{ ft.}$$

Moment: $P_w' \times \bar{y}_{p'w} = 0.50\gamma_w \curvearrowright$ (K-ft/LF)

TAMS

Job No. 1579-16 Sheet 11 of 17
Project Still Lake Dam: Phase I Inspection Date 22 April 81
Subject Stability Analysis: Unusual Loading (½ PMF) By A.D
Ch'k. by

Summation OF Forces and Moments:

(1) ΣF_H : $\vec{P_W} + \vec{P_E} - \vec{P_W'} = 132.3\gamma_w + 66.1\gamma_w - 0.87\gamma_w$

ΣF_H : $197.5\gamma_w \rightarrow$ (K/LF)

(2) ΣF_V : $W_T\downarrow - U\uparrow = 278.3\gamma_w - 117.1\gamma_w$

ΣF_V : $161.2\gamma_w\downarrow$ (K/LF)

(3) $\Sigma M_{resisting}$ (about O) : $\overleftarrow{W_T} + \overleftarrow{P_W'} = 2382\gamma_w + 0.50\gamma_w$

$\Sigma M_{resisting}$: $2382.5\gamma_w\circlearrowleft$ (K-ft/LF)

(4) $\Sigma M_{opposing}$ (about O) : $\overrightarrow{P_W} + \overrightarrow{P_E} + \overrightarrow{U} = 710.5\gamma_w + 253.2\gamma_w + 967.2\gamma_w$

$\Sigma M_{opposing}$: $1931\gamma_w\circlearrowright$ (K-ft/LF)

Resultant Location:

$$\bar{x}_{result} = \frac{2382.5\gamma_w - 1931\gamma_w}{161.2\gamma_w} - \frac{13}{3}$$

$\bar{x}_{result} = -1.53$ ft (outside middle third)

Shear Friction Factor of Safety:

$$S.F.F.S = \frac{\Sigma F_V \tan\phi + cA}{\Sigma F_H} \quad \frac{161.2\gamma_w \tan 25^\circ + 1(13)}{197.5\gamma_w}$$

$S.F.F.S = 1.43 < 3.0$ (No Good)

TAMS

Job No. 1579-16 Sheet 12 of 17

Project Still Lake Dam : Phase I Inspection Date 22 April 81

Subject Stability Analyses : Extreme Loading (PMF) By A.D.

Ch'k. by

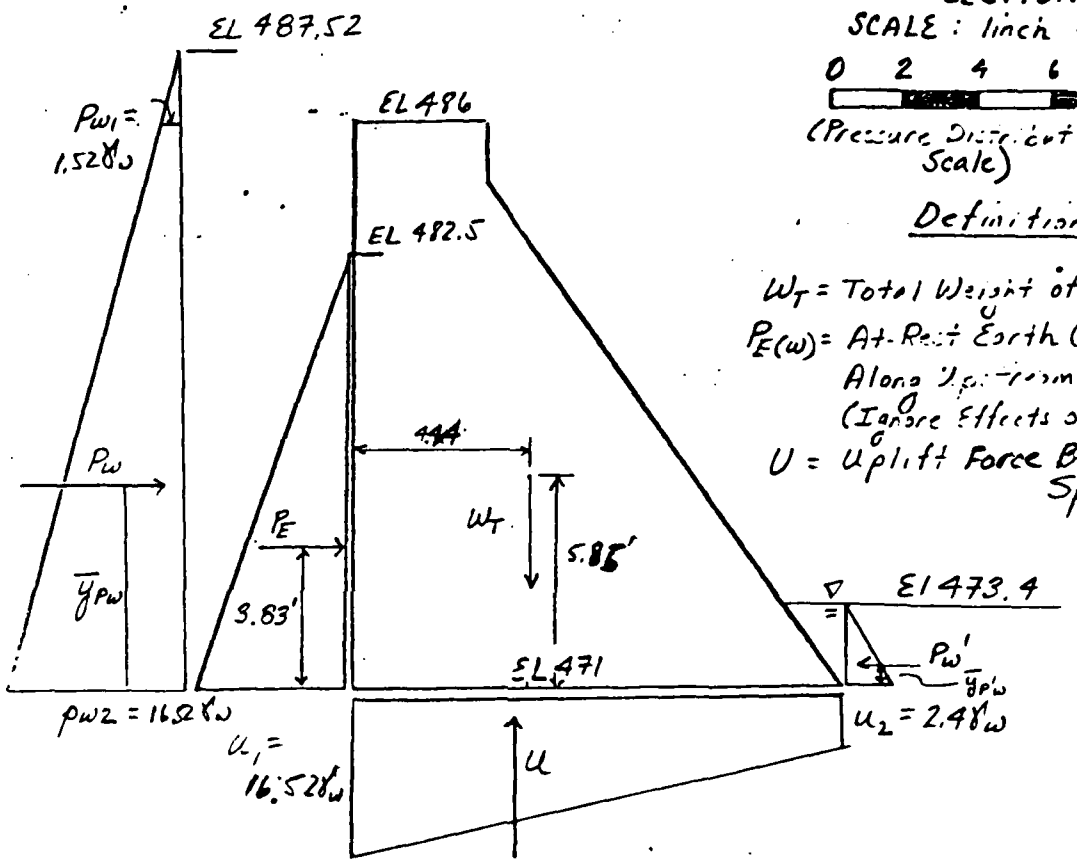
CASE IV : EXTREME LOADING (PMF)

ASSUMED TYPICAL CROSS SECTION

SCALE : 1 inch = 5 feet

0 2 4 6 8 10 ft

(Pressure Distributions Not to Scale)



Definitions:

W_T = Total Weight of Structure

$P_{E(W)}$ = At-Rest Earth (Water) Force Along Upstream Face (Ignore Effects of 1V:6H slopes)

U = Uplift Force Beneath Dam & Spillway

Determine Uplift Force, Location ($\bar{x}_u$) and Moment ($\bar{U}$):

Force:

$$U_1 = (487.52 - 471)\gamma_w = 16.52\gamma_w$$

$$U_2 = (473.4 - 471)\gamma_w = 2.4\gamma_w$$

$$U = \left\{\frac{U_1 + U_2}{2}\right\}(13) = 123\gamma_w \uparrow \text{ (K-ft/LF)}$$

Location:

$$\bar{x}_u = \frac{13\gamma_w\left\{(2.4)\frac{13}{2} + (0.5)(16.52 - 2.4)\left(\frac{13}{3}\right)\right\}}{13\gamma_w\left\{2.4 + 0.5(16.52 - 2.4)\right\}}$$

$\bar{x}_u$ = 4.81 ft

TAMS

Job No. 1579-16 Sheet 13 of 17
Project Still Lake Dam: Phase I Inspection Date 24 April 81
Subject Stability Analysis Extreme Loading (PMF) By A.D.
Ch'k. by

Moment (about O): $u(13 - \bar{x}_u) = 998.8\,\gamma_w$ ↻

Determine P_w Force, Location ($\bar{y}_{pw}$) and Moment:

Force:

$p_{w1} = \gamma_w (487.52 - 486) = 1.52\,\gamma_w$

$p_{w2} = \gamma_w (487.52 - 471) = 16.52\,\gamma_w$

$$P_w = \left\{\frac{p_{w1} + p_{w2}}{2}\right\}(486 - 471)$$

$P_w = 135.3\,\gamma_w \rightarrow$ (K/LF)

Location:

$$\bar{y}_{pw} = \frac{\gamma_w(486-471)\left\{1.52\left(\frac{486-471}{2}\right) + \frac{1}{2}(16.52-1.52)\left(\frac{486-471}{3}\right)\right.}{\gamma_w(486-471)\left\{1.52 + \frac{1}{2}(16.52-1.52)\right\}}$$

$\bar{y}_{pw} = 5.42$ feet

Moment: $P_w(\bar{y}_{pw}) = 733.3\,\gamma_w$ ↻ (K-ft/LF)

Determine P_w' Force, Location ($\bar{y}_{p'w}$) and Moment:

Force:

$P_w' = 0.6\{0.5(473.4 - 471)^2\gamma_w\}$

$P_w' = 1.7\,\gamma_w \leftarrow$ (K/LF)

Location:

$\bar{y}_{p'w} = \frac{1}{3}(2.4) = 0.8$ feet

Moment: $P_w'(\bar{y}'_{pw}) = 1.4\,\gamma_w$ ↺ (K-ft/LF)

TAMS

Job No. 1579-16 Sheet 14 of 17
Project Still Lake Dam: Phase I Inspection Date 24 April 81
Subject Stability Analysis (Extreme Loading: PMF) By A.D
Ch'k. by

SUMMATION OF FORCES AND MOMENTS:

(1) ΣF_H: $\vec{P_W} + \vec{P_E} - \vec{P_W'} = 135.3\gamma_w + 66.1\gamma_w - 1.7\gamma_w$

ΣF_H: $199.7\gamma_w \longrightarrow$ (K/LF)

(2) ΣF_V: $W \downarrow - U \uparrow = 278.3\gamma_w - 123\gamma_w$

ΣF_V: $155.3\gamma_w$ (K/LF)

(3) $\Sigma M_{resisting}$ (about O): $\overleftarrow{W_T} + \overleftarrow{P_W'} = 2382\gamma_w + 1.4\gamma_w$

ΣM_r: $2383.4\gamma_w \curvearrowright$ (K-ft/LF)

(4) $\Sigma M_{opposing}$ (about O): $\vec{P_W} + \vec{P_E} + \vec{U} = 733.3\gamma_w + 253.2\gamma_w + 998.8\gamma_w$

ΣM_o: $1985.3\gamma_w \curvearrowleft$ (K-ft/LF)

Location of Resultant:

$$\bar{X}_{Result} = \frac{\Sigma(M_r - M_o)}{\Sigma F_V} - \frac{B}{4} = \frac{398.1\gamma_w}{155.3\gamma_w} - \frac{13}{4}$$

$\bar{X}_{result} = -0.69$ ft. (outside middle half)

Shear Friction Factor of Safety

$$SFFS = \frac{\Sigma F_V \tan\phi + cA}{\Sigma F_H} = \frac{155.3\gamma_w \tan 25° + 1(13)}{199.7\gamma_w}$$

$SFFS = 1.40 < 3.0$ (No Good)

TAMS

Job No. 1579-16 Sheet 15 of 17

Project Still Lake Dam : Phase I Inspection Date 22 April 81

Subject Stability Analyses : Unusual Loading : Normal Pool w/ Earthquake By A.D.

Ch'k. by

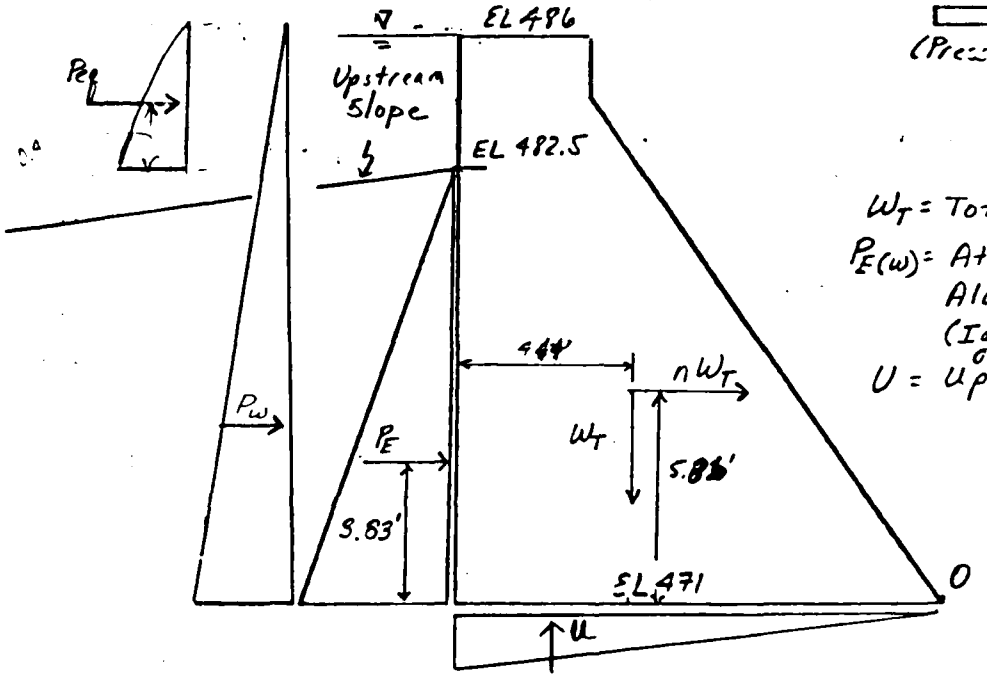
CASE V : UNUSUAL LOADING : NORMAL POOL WITH EARTHQUAKE

ASSUMED TYPICAL CROSS SECTION

SCALE : 1inch = 5feet

0 2 4 6 8 10ft

(Pressure Distributions Not to Scale)



Definition:

W_T = Total Weight of Structure

$P_{E(w)}$ = At-Rest Earth (Water) Force Along Upstream Face (Ignore Effects of IV & H Slopes)

U = Uplift Force Beneath Spillway

Determine Dynamic Force

Water Force (Peq)

Zone 2, n = 0.05

Zangar's Coefficient C = 0.726 when θ = 0

$\overrightarrow{P_{eq}} = 0.726 \times 0.05 \times \gamma_w \times (486 - 482.5)^2 = 0.44\gamma_w \rightarrow$ (K/LF)

$\overrightarrow{M_{PEQ}}$ (about Pt. O) : $P_{eq} \times \{(482.5 - 471) + 0.4(486 - 482.5)\} = 5.78\gamma_w \downarrow$ (K-ft/LF)

Inertia Force (nW_T)

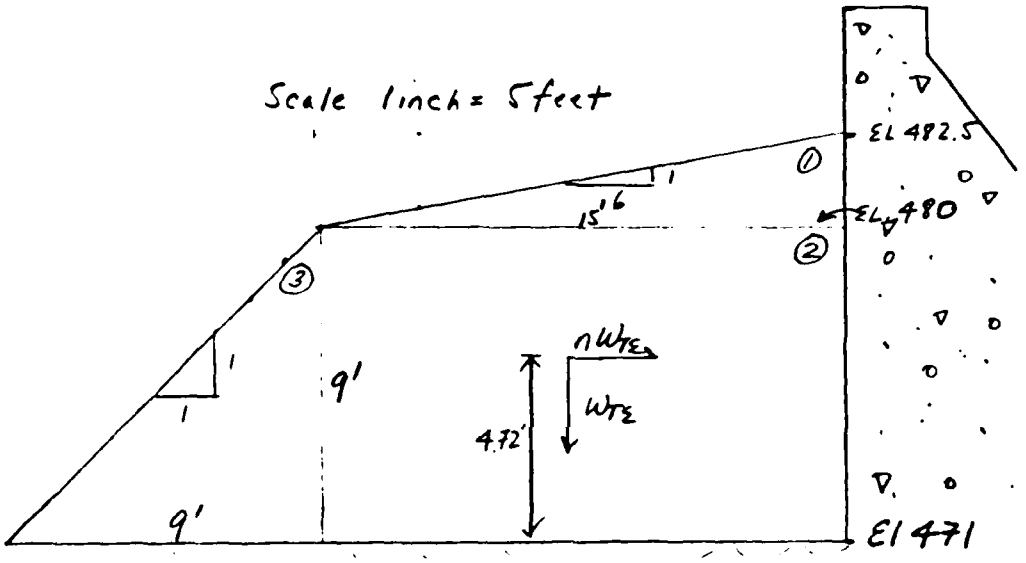
$nW_T = 0.05(278.3\gamma_w) = 13.9\gamma_w \downarrow$ (K/LF)

$M_{nW_T} = 13.9\gamma_w (5.86) = 81.5\gamma_w \downarrow$ (K-ft/LF)

TAMS

Job No. 1579-16 Sheet 16 of 17
Project Still Lake Dam : Phase I Inspection Date 24 Apr. 81
Subject Stability Analysis : (Unusual Loading : Normal Pool with Earthquake) By AD
Ch'k. by

Determine Inertia Force of Upstream Slope Assuming Following Geometry of slope



COMPUTATION OF WEIGHTS

Section	F'	F'_γ	B	H	$F'F_\gamma BH\gamma_w$
1	0.5	2.0	15	25	$38\gamma_w$
2	1.0	2.0	15	9	$270\gamma_w$
3	0.5	2.0	9	9	$81\gamma_w$

$W_{TE} = 389\gamma_w$ (K/LF)
$n = 0.05$
$\therefore nW_{TE} = 19.5\gamma_w$ (K/LF)

Find location of C of G. of u/s Earth Buttress:

$$\bar{y} = \frac{38\gamma_w(9 + \frac{2.6}{3}) + 270\gamma_w(9/2) + 81\gamma_w(9/3)}{38\gamma_w + 270\gamma_w + 81\gamma_w}$$

$\bar{y} = 4.71$ feet $\quad \overset{\frown}{M}_{WTE} = nW_{TE}(\bar{y}) = (19.5\gamma_w)(4.71) = 91.8\gamma_w$ K-FT/LF

TAMS

Job No. 1579-16 Sheet 17 of 17
Project Still Lake Dam: Phase I Inspection Date 24 April 81
Subject Stability Analysis: (Unusual Loading - Normal Pool with Earthquake) By AD
Ch'k. by

Summation of Forces and Moments

(1) ΣF_H : $178.6\,\gamma_w + \vec{P}_{eq} + n\vec{W}_T + n\vec{W}_{TL} = 212.4\,\gamma_w \rightarrow$ (K/LF)

(2) ΣF_V : $180.8\,\gamma_w \downarrow$ (From pg. 5 of 17) (K/LF)

(3) ΣM_{resist} : $2382\,\gamma_w \circlearrowleft$ (From pg. 5 of 17) (K-ft/LF)

(4) ΣM_{oppos} : $1,661\,\gamma_w + \vec{M}_{PEQ} + \vec{M}_{nW_T} + \vec{M}_{WTE}$.

$M_{oppos} = 1840\,\gamma_w \circlearrowright$ (K-ft/LF)

Location of Resultant:

$$\bar{X}_r = \frac{\Sigma (M_r - M_o)}{\Sigma F_V} - \frac{B}{4} \qquad \frac{542\,\gamma_w}{180.8}$$

$\bar{X}_r = 2.99$ within base. OK

Shear Friction Factor of Safety:

$$SFFS = \frac{\Sigma F_V \tan\phi + cA}{\Sigma F_H} = \frac{180.8\,\gamma_w \tan 25 + 1(13)}{212.4\,\gamma_w}$$

$SFFS = 1.37 < 1.5$ NG.

REFERENCES

REFERENCES

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4. "New [illegible] Typical Section", Internal Report, Civil [illegible], Purdue University, West Lafayette, [illegible].

5. Geological Map of New York. The University of The State of New York, The State Education Department, Map and Chart Series No. 5, Albany, New York, 1962.


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